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University of Detroit

BULLETIN

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Announcement of
Co-Operative Engineering Courses

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Announcement of
Co-Operative Engineering Courses

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General Statement.

The remarkable growth, in recent years, in the number of new manufacturing plants in the city of Detroit, and the development and expansion of industries long identified with the city, open a wider and more useful field for competent engineers to direct and bring to more prosperous magnitude these various industrial activities.

The time has long since passed when important technical positions can be filled by promotions from the rank and file of employees who have "grown up with the business." The president of a railroad once said that he could take a technical graduate, and in five years, put him where it would take a man without a technical training, twenty years to reach. This, to a large extent, depends on the man, but the general proposition holds true that the young man, expecting to engage in scientific or engineering pursuits, is seriously handicapped if he has not been specifically trained for his chosen life's work.

The University of Detroit has come to a realization of the fact that industrial education, given in direct contact with the environment where it is afterwards to be applied, will train more efficient and skillful engineers than a course in which the practical application of the theories of the class-room is principally confined to the university shops and laboratories. In conformity with this conviction, the engineering department of the University will, hereafter, be conducted in direct co-operation with the manufacturing plants of the city of Detroit. Prominent manufacturers of the city have already approved this plan and have given the pledge of earnest support.

The trustees of the University, encouraged by the success which has attended this method of training engineers,—notably in Cincinnati, will spare no efforts to make the engineering course a flourishing department of the University. The aim of the course is not to make artisans on the one side, nor experts in abstract science on the other. The co-operative plan strives to make theory and practice go hand in hand. The student, during his course, covers all the subjects which are taught in the best engineering schools of the country, while he learns the practical side of his profession in the field where that profession is later to be exercised.

CO-OPERATIVE SYSTEM.

The co-operative system consists in placing the student at actual shop work for half the time of his course, and keeping him in the class-room where he acquires the theoretical part, for the other half.

To accomplish this, the class is divided into two sections which spend alternate weeks in the class-room and shop. The term "shop," in this case, refers to the place of the student's practical employment (see Shop Work, page 12), and may be either in a pattern, foundry, forge or machine shop, or with a construction gang or a surveying party,—depending upon the course of study he has chosen.

To obtain the best efficiency from this method, a co-ordinator, a man with both shop and college training, is engaged in co-ordinating the work of the shop with that of the University. He gives lectures and holds quiz periods for the sections in the University, and keeps an accurate record of the standing and efficiency of the students at the shops and factories.

ADVANTAGES OF THE PLAN.

In most instances, a graduate from one of the technical schools finds great difficulty in making the transition from a college student to a practical engineer. It is usually conceded that he should begin his practical work in the shop, but after so many years of school habits, he is apt to be tempted from the monotonous routine of the shops to the shorter hours and more congenial surroundings of the draughting room or business office. Thus, an important link is often omitted in the engineer's training.

On the other hand, this system not only requires actual work on the part of the student, but gives it at the best possible time; i.e., together with the theory. Then too, at the very outset, it affords the student the opportunity of discovering whether engineering should be his chosen profession, and if so, just what branch is most congenial to his tastes and qualifications. It also enables him to display before his employers the talent and ability which will assure him a ready welcome when he is in quest of employment,—but above all, it will launch him upon his career with the knowledge that nothing is accomplished without great labor.

Still another advantage to the student is the fact that while in the shop he is paid for his services at an hourly rate ranging from ten to twenty-five cents, depending upon the class and nature of the work, and his efficiency. Thus he is enabled to defray a great portion of his college expenses.

PARTIAL LIST OF CO-OPERATING PLANTS.

American Blower Company.
American Pattern Works.
American Car and Foundry Co.
Detroit Shipbuilding Co.
Detroit Stove Works.
Detroit United Railway.
Edison Illuminating Company.
Fulton-National Brass Company.
General Motors Company.
Great Lakes Engineering Co.
Michigan Stove Works.
Peninsular Stove Works.
Russel Wheel and Foundry Co.
United States Tire Company.

Courses Offered.

As will be noted from the appended schedule of studies, three complete engineering courses are offered, Mechanical, Civil and Electrical.

For the first two years the studies are common to all courses, so that the student need not determine upon the particular branch until the end of his second year. The following brief synopsis of each course will help the student to make an intelligent choice.

MECHANICAL ENGINEERING.

Besides the fundamental sciences common to all branches of engineering, this course offers special opportunities in steam and gas engineering, and power-plants.

The work, special to this branch, includes the designing of steam and gas engines and steam turbines, and a study of methods of power distribution and application by both mechanical and electrical means. Complete power-plant designs are made both for the generation of electrical power and for direct use in manufacturing plants, and students become familiar with all forms of steam, gas, and electrical machinery through their study and operation in the course at the University and in the shops. This course also includes the designing of shops, traveling cranes and power distribution systems. The course is intended to train production engineers and managers of manufacturing plants of all kinds.

CIVIL ENGINEERING.

The first aim is to impart as broad a scientific training as the length of the course and the essential professional studies will allow, so that as many avenues to successful service as possible may be open to the graduate. Along professional lines, emphasis is laid first, on work in surveying and field methods, as these are of special value to civil engineers; second, on mechanics and its applications to the design of roofs, bridges and other structures; third, on the theory and practice of re-enforced concrete construction; fourth, on railway location and construction; fifth, on sanitary and municipal engineering, including water supply, sewerage, roads and pavements.

A specialized course in bacteriology, particularly in its relation to water supply and sewerage, a broad and general study of sanitary science as related to public health problems, courses in the design of engineering structures related to sewage disposal and water purification. Stress is placed on the study of principles as being the things not likely to be acquired in after-life.

ELECTRICAL ENGINEERING.

The course of Electrical Engineering is designed to train the student in the building of power-plants; in the electrification of shops, tunnels, railroads, cities; in the transmission and distribution of power; in telephoning, and wireless telegraphy. The co-operative plan of engineering calls for a wide and varied experience in practical electrical work. The aim of the entire course is to develop in the student those qualities which are essential to the engineer, as well as those that are essential to the electrical artisan.

OPEN LECTURE SERIES.

In addition to the regular courses shown in the following schedule, arrangements are being made for a series of free and open lectures to be given by prominent engineers and enterprising and progressive manufacturers of the city. This readiness of outside engineers and manufacturers to co-operate with us is taken as a most favorable presage of success. It shows that they welcome the appearance of the school, and are willing to contribute to its efficiency. May we not hope that in turn this new department will afford inspiration and insure thoroughness and progress in every line of high-grade scientific engineering work in Detroit and vicinity?

ENTRANCE REQUIREMENTS.

Candidates for admission must be at least sixteen years of age. They must either present a certificate of graduation from an accredited high school, or give evidence of having satisfactorily completed an amount of preparatory study represented by fifteen units, as explained below. A unit is understood to mean one full school year of five recitations per week.

The units which are presented must include the following:

English	3 units
Algebra through Quadratics	1 unit
Geometry (Plane and Solid)	1 unit
Physics	1 unit
History	1 unit
Language	2 units
	9 units

The remaining six units may be selected from the following list:

Manual Training	2 units	German	2 units
Drawing	1 or 2 units	French	2 units
Civics	½ unit	Spanish	1 unit
History	1 unit	Latin	2 units
Astronomy	½ unit	Greek	2 units
Geology	½ unit	English	1 unit
Physical Geography	½ or 1 unit		
Chemistry	1 unit		
Trigonometry	½ unit		

Candidates who cannot furnish the required admission credentials will be required to pass special examinations in entrance deficiencies (which will be given at the beginning of each academic year), or must make up such work in our own or some other approved high school.

Examinations for admission will take place during the week of Sept. 9-14. Classes begin on Monday, Sept. 16.

Advanced Standing: Those who have satisfactorily pursued studies beyond the admission requirements may be admitted to advanced standing.

Special Students: Persons wishing to do university work in engineering will be admitted to lectures and shops as special students on payment of special fee. Should such afterwards desire to apply for a degree, they must first satisfy all the entrance requirements.

Good character, gentlemanly deportment and compliance with the rules of University discipline are all that will be demanded of candidates in a moral way. No religious test or obligation is imposed.

DEGREES: The degree of Bachelor of Civil Engineering, Bachelor of Mechanical Engineering, and Bachelor of Electrical Engineering will be given to students who have satisfactorily completed the five years of study as mapped out on the following pages.

TERMS IN THE ENGINEERING COURSE.

All fees must be paid in advance to the treasurer of the University. A matriculation fee of Five Dollars is paid by all students of the University before entering upon any course, and entitles them to permanent membership in the University.

Regular students in the Engineering Department pay an annual tuition fee of One Hundred Dollars, payable in two equal installments before the beginning of each semester. These installments must be in the hands of the treasurer before students will be allowed to enter upon the semester's work.

Special students will be charged a fee of Three Dollars per credit.

A Laboratory fee of Five Dollars will be charged for each semester's course in the Physical, Chemical, Mechanical, Civil and Electrical Laboratories.

A small deposit for breakage will also be required in these courses.

Further particulars may be had by applying to the "Registrar," University of Detroit, 363 Jefferson Ave., Detroit, Michigan.

PLAN OF INSTRUCTION.

The course of study during the year covers a period of eleven months, alternating between class and shop work the entire time. While the two branches of this course, the practical shop work and the theoretical class-room work, are coordinated very closely, yet they are two distinct departments.

Shop Work: While the student is in the shop, he is on the same level as his fellow workmen, being entirely responsible to his foreman. Suspension from the shop,—if deemed justifiable by the Faculty, will mean suspension from the University.

Students in Mechanical Engineering will take their practical work in pattern, forge and machine shops, the time being divided so as to obtain the best possible results. Those in Electrical Engineering will be assigned to the regular pattern and forge shops, and machine shops of Electrical Companies, with some time spent on electrical installations. The students in Civil Engineering will spend their time partly in the shops, but mostly with surveying parties and construction gangs.

In these different places of employment the student's attention is not only called to the various operations of his particular work, but also to the general systems of the shop, such as the "routing" of the work, the handling of the men and the layout of the plant. The methods of heating, furnishing power, etc., are also discussed. Moreover, the student has an excellent opportunity to become familiar with practical working drawings.

Classroom Work: The following schedule gives the arrangement of this work. In this schedule, it will be noted, each hour of recitation or lecture per week for one semester is counted as one credit. Each hour of a laboratory period is counted as 1/2 credit, while each hour of drawing period is valued as 1/3 credit.

The first two years of the Mechanical, Electrical and Civil Engineering courses are identical. For the academic year 1912-1913, only the subjects shown in the freshman and sophomore years will be given.

Schedule of Studies.

MECHANICAL ENGINEERING.

FIRST SEMESTER—FRESHMAN YEAR.

Subject.	Course.	Hours.	Credits.
Trigonometry	Math. 1	5	5
Chemistry	Ch. 1	4	4
Chemistry, Laboratory	Ch. 1a	6	3
Drawing	M. E. 1	9	3
Co-ordination	C. 1	2	2
English	Eng. 1	2	2
German	Ger. 1	3	3
		31	22

SECOND SEMESTER—FRESHMAN YEAR.

Subject.	Course.	Hours.	Credits.
College Algebra	Math. 2	5	5
Chemistry	Ch. 2	4	4
Chemistry, Laboratory	Ch. 2a	4	2
Descriptive Geometry, Recitation	M. E. 2	3	3
Descriptive Geometry, Drawing	M. E. 2a	9	3
English		2	2
Co-ordination	C. 2	2	2
German	Ger. 2	3	3
		32	24

FIRST SEMESTER—SOPHOMORE YEAR.

Subject.	Course.	Hours.	Credits.
Analytical Geometry	Math. 3	5	5
Physics (Heat and Light)	Physics 1	4	4
Physics, Laboratory	Physics 1a	4	2
Co-ordination	C. 3	2	2
Qualitative Analysis	Ch. 3	1	1
Qualitative Analysis, Laboratory	Ch. 3a	6	3
English		2	2
German	Ger. 3	3	3
		27	22

SECOND SEMESTER—SOPHOMORE YEAR.

Subject.	Course.	Hours.	Credits.
Differential Calculus	Math. 4	5	5
Physics (Mechanics and Sound)	Physics 2	4	4
Physics, Laboratory	Physics 2a	4	2
Co-ordination	C. 3	2	2
Mechanisms	M. E. 3	5	5
Mechanisms (Drawing)	M. E. 3a	6	2
Metallurgy	Ch. 6	2	2
		28	22

FIRST SEMESTER—PRE-JUNIOR YEAR.

Subject.	Course.	Hours.	Credits.
Integral Calculus	Math. 5	5	5
Physics (Electricity and Magnetism)	Physics 3	4	4
Physics, Laboratory	Physics 3a	4	2
Machine Drawing	M. E. 4	9	3
Steam Engines	M. E. 5	5	5
English		2	2
Co-ordination	C. 4	2	2
		31	23

SECOND SEMESTER—PRE-JUNIOR YEAR.

Subject.	Course.	Hours.	Credits.
Mechanics	Math. 6	4	4
Surveying, Recitation	C. E. 4	1	1
Surveying, Field Work	C. E. 4a	6	3
Co-ordination	C. 5	2	2
Structural Mechanics	C. E. 1	5	5
Economics		2	2
Electrical Engineering	E. E. 1	4	4
Electrical Engineering, Laboratory	E. E. 1a	4	2
		28	23

FIRST SEMESTER—JUNIOR YEAR.

Subject.	Course.	Hours.	Credits.
Strength of Materials	C. E. 2	5	5
Machine Design	M. E. 8	5	5
Electrical Engineering	E. E. 2	4	4
Electrical Engineering, Laboratory	E. E. 2a	4	2
Machine Design (Drawing)	M. E. 9	6	2
Valve Gears	M. E. 6	3	3
Co-ordination	C. 6	2	2
		29	23

SECOND SEMESTER—JUNIOR YEAR.

Subject.	Course.	Hours.	Credits.
Machine Design	M. E. 10	9	3
Thermodynamics	M. E. 11	5	5
Hydraulics	C. E. 3	4	4
Trips of Inspection		2	1
Economics		3	3
Heating and Ventilating	M. E. 20	3	3
English (Public Speaking)		2	2
Co-ordination	C. 7	2	2
		30	23

FIRST SEMESTER—SENIOR YEAR.

Subject.	Course.	Hours.	Credits.
Steam Laboratory	M. E. 7	8	4
Steam Turbines	M. E. 18	3	3
Hoisting Machinery	M. E. 12	9	3
Gas Engines	M. E. 14	3	3
Hydraulic Machinery	C. E. 7	3	3
English		2	2
Economics		3	3
		31	21

SECOND SEMESTER—SENIOR YEAR.

Subject.	Course.	Hours.	Credits.
Steam Laboratory	M. E. 13	8	4
Marine Engineering	M. E. 19	3	3
Power Plants	M. E. 15	3	3
Gas Engine Design	M. E. 16		
or			
Automobile Design	M. E. 17	8	4
Thesis		6	6
		28	20

CIVIL ENGINEERING.

FIRST SEMESTER—PRE-JUNIOR YEAR.

(Freshman and Sophomore Years same as Mechanical Engineering.)

Subject.	Course.	Hours.	Credits.
Integral Calculus	Math. 5	5	5
Physics (Electricity and Magnetism)	Physics 3	4	4
Physics, Laboratory	Physics 3a	4	2
Topographical Drawing	C. E. 5	9	3
Steam Engines	M. E. 5	5	5
English		2	2
Co-ordination	C. 4	2	2
		31	23

SECOND SEMESTER—PRE-JUNIOR YEAR.

Subject.	Course.	Hours.	Credits.
Mechanics	Math. 6	4	4
Surveying, Recitation	C. E. 4	1	1
Surveying, Field Work	C. E. 4a	6	3
Structural Mechanics	C. E. 1	5	5
Economics		2	2
Electrical Engineering	E. E. 1	4	4
Electrical Engineering, Laboratory	E. E. 1a	4	2
Co-ordination	C. 5	2	2
		28	23

FIRST SEMESTER—JUNIOR YEAR.

Subject.	Course.	Hours.	Credits.
Strength of Materials	C. E. 2	5	5
Electrical Engineering	E. E. 2	4	4
Electrical Engineering, Laboratory	E. E. 2a	4	2
Geology		3	3
Mineralogy		3	3
Co-ordination	C. 6	2	2
Surveying	C. E. 6	6	3
		27	22

SECOND SEMESTER—JUNIOR YEAR.

Subject.	Course.	Hours.	Credits.
Surveying	C. E. 8	8	4
Hydraulics	C. E. 3	4	4
Framed Structures	C. E. 9	5	5
Economics		3	3
English (Public Speaking)		2	2
Trips of Inspection		2	1
Electives		2	2
Co-ordination	C. 8	2	2
		28	23

FIRST SEMESTER—SENIOR YEAR.

Subject.	Course.	Hours.	Credits.
Gas Engines	M. E. 14	5	5
Hydraulic Machinery	C. E. 7	3	3
English		2	2
Economics		3	3
Cement Theory	C. E. 10	3	3
Civil Engineering, Laboratory	C. E. 11	6	3
Structural Design	C. E. 12	9	3
		31	22

SECOND SEMESTER—SENIOR YEAR.

Subject.	Course.	Hours.	Credits.
Power Plants	M. E. 15	3	3
Municipal Engineering	C. E. 13	5	5
Engineering Design	C. E. 14	9	3
Sanitary Engineering	C. E. 15	2	2
Thesis		6	6
		25	19

ELECTRICAL ENGINEERING.

FIRST SEMESTER—PRE-JUNIOR YEAR.

(Freshman and Sophomore Years same as Mechanical Engineering.)

Subject.	Course.	Hours.	Credits.
Integral Calculus	Math. 5	5	5
Physics (Electricity and Magnetism)	Physics 3	4	4
Physics, Laboratory	Physics 3a	4	2
Machine Drawing	M. E. 4	9	3
Steam Engines	M. E. 5	5	5
English		2	2
Co-ordination	C. 4	2	2
		31	23

SECOND SEMESTER—PRE-JUNIOR YEAR.

Subject.	Course.	Hours.	Credits.
Mechanics	Math. 6	4	4
Surveying, Recitation	C. E. 4	1	1
Surveying, Field Work	C. E. 4a	6	3
Structural Mechanics	C. E. 1	5	5
Economics		2	2
Electrical Engineering	E. E. 1	4	4
Electrical Engineering, Laboratory	E. E. 1a	4	2
Co-ordination	C. 5	2	2
		28	23

FIRST SEMESTER—JUNIOR YEAR.

Subject.	Course.	Hours.	Credits.
Strength of Materials	C. E. 2	5	5
Electrical Engineering	E. E. 2	4	4
Electrical Engineering, Laboratory	E. E. 2a	4	2
Electrical Design	E. E. 4	9	3
Telephones	E. E. 9	2	2
Machine Design	M. E. 8	5	5
Co-ordination	C. 6	2	2
		31	23

SECOND SEMESTER—JUNIOR YEAR.

Subject.	Course.	Hours.	Credits.
Electrical Machinery	E. E. 3	5	5
Electric Power Transmission	E. E. 5	3	3
Hydraulics	C. E. 3	4	4
Economics		3	3
English (Public Speaking)		2	2
Trips of Inspection		2	1
Co-ordination	C. 9	2	2
		21	20

FIRST SEMESTER—SENIOR YEAR.

Subject.	Course.	Hours.	Credits.
Steam Turbines	M. E. 18	3	3
Economics		3	3
English		2	2
Illumination	E. E. 10	3	3
Electrical Laboratory	E. E. 11	8	4
Electrical Design	E. E. 6	9	3
Electives		3	3
		31	21

SECOND SEMESTER—SENIOR YEAR.

Subject.	Course.	Hours.	Credits.
Power Plants	M. E. 15	3	3
Electrical Design	E. E. 8	6	2
Electrical Railroads	E. E. 7	2	2
Electives		6	6
Thesis		6	6
		23	19

Description of Studies.

MECHANICAL ENGINEERING.

M. E. 1. Elementary Drawing:—Use of instruments, lettering, geometrical figures, elementary projections, difference between first and third angle projections and drawing room standards. The drawing room standards include methods of dimensioning, cross sectioning, and representing screw threads, bolts, nuts, etc. Some time is spent in tracing and blue printing. Great care is exercised is this course to give the student a knowledge of the best practice used in the most modern draughting rooms.

M. E. 2. Descriptive Geometry:—By means of orthographic projections; points, lines, and surfaces in space are represented accurately upon a single plane, i. e., the drawing plate. A thorough study is made of the different kinds of surfaces, such as plane, single curved, double curved and warped surfaces, with tangent, normal and intersecting planes. Lines of intersection and developments are considered at length. This course includes recitations, lectures and drawing periods.

M. E. 3. Mechanisms:—Investigation of the laws of kinematics. Solution of problems by means of instant centers, designing of cams, gears, linkage, etc. Recitations, lectures and drawing periods.

M. E. 4. Machine Drawing:—Continuation of M. E. 1 with special emphasis placed upon making practical working drawings of machine parts. The method employed is that of making free-hand sketches from which the detail drawing is made. From the detail drawings, assembly drawings are made, thus checking their completeness.

M. E. 5. Steam Engines:—The principal power-producing machines are here studied, but principally the steam boiler and engine, and the gas producer and gas engine. Considerable time is given to the steam turbine.

M. E. 6. Valve Gears:—A study of the various kinds of valves used on steam and gas engines is taken up. A study is made of the Zeuner and Bilgrim diagrams with problems applied to steam valves. Considerable time is given to the study of the Stephenson, the Walschaert and the Joy Valve Gears. Governors are also considered.

M. E. 7. Mechanical Laboratory:—The aim in this course is to give the student actual practice in the use of steam engine testing apparatus. With this in view they are taught to calibrate steam engine indicators, thermometers, gauges, etc. The determination of the calorific value of coal, gas and oil is also taken up. The students' services as helpers will be offered to engineers in the city who are making tests on plants of all descriptions.

M. E. 8. Machine Design, Theoretic:—This is a course in which the theory taken up in C. E. 1 and 2 is used in designing machine parts. These parts include bolts, journals, shafts, pulleys, gears, connecting and piston rods, and frame works of machines. Recitations and lectures only.

M. E. 9. Machine Design, Drawing:—The design of boiler and steam engine parts is worked out carefully in the drawing room. This course gives the student ample opportunity to apply the principles learned in M. E. 8. As in all other drawing courses, reliable and practical working drawings are insisted upon.

M. E. 10. Machine Design, Tools:—Design of jigs, fixtures, and other machine tools.

M. E. 11. Thermodynamics:—In this course a study is made of the properties of gases and vapors under different conditions, as applied to the steam and gas engine, air compressor and refrigerating machine.

M. E. 12. Hoisting Machinery:—The object of this course is to give the student an opportunity to apply the theory of M. E. 8 to a structural machine,—the design of columns, girders, ropes and sheaves is included.

M. E. 13. Steam Laboratory:—Some of the time allotted to this course will be spent in the University laboratory, but the course consists principally in testing engines, turbines, boilers, etc., in plants about the city.

M. E. 14. Gas Engines:—This is a course of lectures and recitations covering the various types of gas engines. It includes a study of gas engine operation, testing and installation.

M. E. 15. Power Plants:—The arrangements, size and cost of the various units that are necessary in laying out a power house are here studied. Specifications for steam plants are also taken up.

M. E. 17. Automobile Design:—The principal parts that go into the automobile are carefully laid out, and working drawings made.

M. E. 18. Steam Turbines—This course consists of lectures, recitations and problems covering the theory and construction of steam turbines. It includes a study of the principal points of both impulse and reaction turbines, such as nozzles, blades, etc., along with the commercial types. Efficiency and adaptability of turbines as compared with other power producers is an important feature.

M. E. 19. Marine Engineering:—A brief study is made of the engineering equipment of ships, such as types of engines, boilers, condensers, screws, paddle wheels, etc. The lake steamers will be considered principally.

M. E. 20. Heating and Ventilating:—In this course a study is made of the methods employed in heating and ventilating residences, shops and offices. The various kinds of heating systems as hot water, direct and indirect steam, and hot air are studied. Typical plants in the city are inspected and discussed. Lectures will be given by prominent engineers.

CIVIL ENGINEERING.

C. E. 1. Structural Mechanics:—In this course the theoretical principles of mechanics are applied to engineering structures. These include the determination of the stresses in the members that go to make up the roof trusses, bridges, arches, etc., the location of the centers of inertia, and the findings of the radii of gyration of cross-sections. Plotting of bending moment and shear diagrams is also covered.

C. E. 2. Strength of Materials:—The various properties of materials are studied to determine their ability to resist the stresses investigated in C. E. 1. The resisting moment of the materials in various shapes, such as common steel sections and timber and reinforced concrete beams. Pieces in compression, such as columns, posts and struts are investigated by means of Schneider's and Worster's formulae. Internal stresses in structural pieces are analyzed.

C. E. 3. Hydraulics:—In this course a study is made of the performance of water in its many applications to engineering work. This considers its flow through pipes, channels and orifices, and over weirs. Losses by friction in pipes is an important item. Practical problems in hydro-electrical plants are also discussed.

C. E. 4. Surveying:—One hour a week is given to lecture or quiz in the use of surveying instruments and methods of making surveys. It includes the reading of instruments, measuring distances and angles, staking out, measuring and computing traverses, running levels, making profiles and platting.

C. E. 4a. Surveying Field Work:—The class is divided into squads and detailed to different parts of the city to make the surveys, run sets of levels, etc.,—thus becoming perfectly familiar with the instruments and methods employed in surveying. The work in the field is carefully computed and tabulated in a field note-book.

C. E. 5. Topographical Drawing:—This course consists of a study of the practice in the conventional methods of representing topography, together with the platting of the results of field practice in connection with surveying. A complete map of a section in the city is required of each student.

C. E. 6. Surveying:—This course is required only of Civil Engineering students, and is part review and part extension of C. E. 4. Besides the subjects mentioned in that course, railroad curves, earthwork surveys and city platting is taken up.

C. E. 7. Hydraulic Machinery:—Water turbine theory and practice are studied along with other water power station machinery.

C. E. 8. Railroad Surveying:—In this course complete surveys are made for sections of both street and steam railroads. Curves, etc., of track already laid are surveyed and checked with theory given in text-books. The setting out of simple and compound curves and calculation of excavations and embankments. Yards, turnouts, and switches. Easement curves of various types. Calculation of water-ways, and methods of staking out foundations for culverts and bridges. Some time may be spent with the surveying parties of the railroads in the city.

C. E. 9. Framed Structures:—In this course an investigation is made of the stresses in trusses, arches, draw spans, etc. It applies the theory of C. E. 1 to specific problems. Various styles of trusses are studied and their members analyzed.

C. E. 10. Cement Theory:—The use of cement in the building of reinforced concrete structures, and solid cement work is studied. The extensive use of this material in buildings of all description makes this course of great importance. Practical examples are worked out. Part of the course will be given over to lectures by prominent engineers.

C. E. 11. Civil Engineering, Laboratory:—Torsion, compression, bending and shearing tests of timber, metals and concrete are carried on, and checked with the theory given in C. E. 1 and 2.

C. E. 12. Structural Design:—A complete framed structure is designed, and working drawings made. Here, as in all other designing courses, practical working drawings are insisted upon.

C. E. 13. Municipal Engineering:—Construction of sewers, streets, pavements, etc., and their locations in cities, are taken up. This course will consist principally of lectures given by experts engaged in this work.

C. E. 14. Engineering Design:—In this course further practical application of the theoretical problems is made. It includes some complete structure, such as power building, mill, or small office building. As in all other drawing courses the plates must be practical working drawings.

C. E. 15. Sanitary Engineering:—A broad and general view of the large body of sanitary science upon which the modern practice of sanitation is based. The effects of good practice in such matters as public water supply, sewerage and drainage, state and federal control over the pollution of streams, the elimination of dust and mud and snow from city streets, and the ventilation of public buildings. The course will consist mostly of lectures by prominent engineers.

ELECTRICAL ENGINEERING.

E. E. 1. Direct Current Machinery:—In this course a partial review of that part of physics which deals with electricity is first taken up. This is followed by a careful study of the direct current motor, generator, the storage battery, etc. On account of the important part that electricity now plays in nearly every engineering project, this course is required of all students, and is made very thorough. The course consists of lectures, problems and recitations.

E. E. 1a. Direct Current, Laboratory:—Actual tests are made to determine the efficiency, performance, etc., of various types of direct current machines.

E. E. 2. Alternating Current Machinery:—The object of this course is to give the student a fair understanding of the alternating current and its many important applications. The motor, generator, converter, mercury arc rectifier and transformer are studied in detail.

E. E. 2a. ALTERNATING CURRENT MACHINERY, LABORATORY:—Tests are made upon the various machines, both in the University laboratory, and in the power plants of the city.

E. E. 3. ELECTRICAL MACHINERY:—This course reviews courses E. E. 1 and 2, and takes up in greater detail the machines studied therein. Special study is made of the theory of the alternating current and its application. Operation of electrical machinery is an important item.

E. E. 4. DIRECT CURRENT ELECTRICAL DESIGN:—In this course the complete design is made of a direct current motor and an electro-magnet. Practical working drawings are insisted upon.

E. E. 5. ELECTRIC POWER TRANSMISSION:—The central electrical station, and long distance transmission lines are studied.

E. E. 6. ALTERNATING CURRENT ELECTRICAL DESIGN:—This course is similar to E. E. 4, but considers only alternating machines, such as transformers, converters, etc.

E. E. 7. ELECTRICAL RAILROADS:—The aim here is to give the student a fair idea of the solution of the principal problems met in electrical railroads. These include the determination of power required by trains, methods of electrical transmission, arrangement of schedules, etc.

E. E. 8. ELECTRICAL DESIGN:—The electrical part of the installation of a modern power house is designed. Details of the switchboards, conduits, generators and motor settings are made.

E. E. 9. TELEPHONES:—A study is made of the theory of the electrical transmission of speech. Long distance and local systems are investigated. Time is given to the inspection of central stations, and wherever possible, lectures by telephone experts are given.

E. E. 10. ILLUMINATION:—A study is made of the theory of illumination, and the practical methods employed in furnishing light for streets and buildings.

E. E. 11. Electrical Laboratory:—Advanced experiments with electrical machinery, and the testing of machines. As far as possible these tests will be made in the electrical plants of the city.

MATHEMATICS.

1. Trigonometry:—Definitions and relations of trigonometric functions; logarithms; solution of trigonometric equations. Determination of sides, angles and areas of right and oblique triangles in both plane and spherical trigonometry. Some time is given to practice in the use of both logarithmic and trigonometric tables, and solution of original problems.

2. Advanced Algebra:—Review of surds, imaginaries and quadratic equations and their geometrical representation. Special study is made of binomial theorem, permutations and combinations, and convergence and divergence.

3. Analytical Geometry:—The object of this course is to familiarize the student with analytical methods of investigation; representation of the straight line, circle, parabola, ellipse and hyperbola by means of equations. A short time is devoted to solid analytic goemetry.

4. Differential Calculus:—A very thorough course in differential calculus is given, including variables, functions and limits, differentiation, maxima and minima, radii and centers of curvature and tracing of curves.

5. Integral Calculus:—Methods of integration as applied to finding of areas, volumes, length of curves, and moments of inertia.

6. Mechanics:—This course brings together all the principles of physics and mathematics that have a direct bearing on the purely engineering subjects which follow it in the course. It takes up the laws of motion, such as momentum, force and energy. Parallel and concurrent forces, statics, principles of work, rectilinear and curvilinear motion, and finally centers of inertia and radii of gyration are very carefully considered.

CHEMISTRY.

1. Elementary Inorganic Chemistry:—A study of the occurrence, preparation, physical and chemical properties of metals and non-metals. Their use and application in the arts. Symbols and equations. Laws of definite and multiple proportion. Equivalent, molecular and atomic weights. Oxidation, reduction, decomposition, dissociation, ionization and hydrolysis.

2. Inorganic Chemistry:—A thorough study of metals and non-metals, their classification, their use in engineering problems. Kinetic molecular hypothesis. Theory of solution and dissociation. Colloids, hydrosols and hydrogels. Chemical equilibrium, ionization and the interaction of ionic substances. Ionic theory of precipitation and solution complex ions.

1a and 2a. Chemical Laboratory:—A selection of experiments will enable the student to familiarize himself with the elements and compounds, but especially fit him to attack the problems that may present themselves to the practical engineer.

3. Qualitative Analysis:—Analytical actions, separations and identifications in the light of modern theories of ionic solution and equilibrium.

3a. Qualitative Laboratory:—In the laboratory, selected reactions and separations which exercise the observational and reflective powers of the student, whilst giving the technical knowledge necessary to discover the constituents of simple alloys, ores and minerals.

4. Quantitative Analysis:—Determination of exact amount of each of the different constituents in any compound. Gravimetric and volumetric. Elective.

5. Organic Chemistry:—Introduction to the carbon compounds and their principal derivatives. Elective.

6. Metallurgy:—Fuels and other means of obtaining high temperatures. Furnaces and their accessories. Treatment of the principal iron ores.

GENERAL PHYSICS.

Instruction in Physics is given by lectures illustrated by numerous demonstrations and by recitations from lessons assigned in a text-book. The object of the course is to acquaint the student with experimental facts, as well as with the quantities used in Physics and the theory and method of calculation. Particular attention is given to the fundamental principles and the solution of problems of a practical nature. A special effort is made to adapt the course to the needs of technical students. For this reason, most of the time will be given to such subjects as are correlated to later technical work.

The course includes the treatment of the mechanics of solids, liquids and gases; heat, sound, light, magnetism and electricity.

Text-book: Carhart, University Physics.

Laboratory Physics: The laboratory experiments are intended to give the students,—not only a practical knowledge in the use of standard apparatus, and training in the methods of making and recording physical measurements,—but also a firmer grasp and clearer insight into the physical laws and phenomena. More stress is laid on the grasp of principles and personal resourcefulness on the part of the student than on mere skill in following a set of directions. The student is required to keep an accurate and detailed record of every experiment performed. The work required is not only accurate, but as far as possible, individual,—and great importance is laid on the discussion of the sources of error.

Experiments in the branches of the different subjects are selected from laboratory manuals of Ames & Bliss, Stewart & Gee, Miller, Millikan and others. Accurate measurements of length, mass and density, by means of comparator, cathetometer and balance; the determination of the constants of gravity, inertia, and elasticity; calometric measurements; the use of the spectroscope, spectrometer, polariscope, and grating; determination of the velocity and pitch of sound; magnetic and electrical measurements are among the more important exercises.

CO-ORDINATION.

C.1 to C.9: These courses consist of two class periods per week in the University. The students from the various shops are brought together into one class, and their difficulties and experiences are discussed. In this way a very broad idea of the work carried on in the several shops is brought to each student. The student will, from time to time, be expected to write reports on what he has observed in the shop, and read them before the class.

INSPECTION TRIPS.

Detroit offers great opportunity for visiting engineering plants of all descriptions. Among the works inspected are electric lighting, shipbuilding, automobile, railroad car, stove, steam engine, blower, and bridge companies. The material for many of the themes for the English courses will be taken from these trips.

ENGLISH.

The first year's English consists of a brief review of the principles of rhetoric with special attention to the theme and paragraphic unit. Theme writing is begun at once with special emphasis upon clear and concise expression of thought. The student is soon required to write reviews of leading articles in current scientific periodicals, the aim constantly being to obtain a natural and exact expression of thought.

One hour per week is spent in text book study, which also comprises a study of English and American masterpieces, and one hour per week is given to theme work as noted above.

Unless the student already possesses a literary education, he is also required to do a certain amount of outside reading. This reading comprises works of poetry, fiction, history, biography and science.

The second year continues the theme work, but a large share of the subject matter is furnished by inspections of the many engineering problems and constructions, which only a large city can furnish. The student is encouraged to observe and to express in scientific language what he has seen. Here also the study of English and American masterpieces is continued.

The Junior and Senior years continue the study of English as shown in the course of study. Twelve hours of English is required to satisfy the requirements for graduation, but beginning with the Junior year, the course will be largely determined by the efficiency and needs of the class. The course will constantly aim at stimulating careful observation and logical thinking, which form the basis of clear expression.

MODERN LANGUAGES.

This course at present offers German only. Nine hours are required to qualify for graduation from each course offered in the Engineering Department.

Students offering German as one of their entrance requirements may take the second year's technical German for part of their language credit.

The object of the course in German is to give the student a working knowledge of reading, writing and speaking,—with special emphasis upon comprehensive reading. The medium of class communication is changed from English to German as early as is practicable.

The first year is devoted to German grammar, and enough theme writing and classic reading to acquire a reasonable knowledge of German idioms, constructions and methods of thought.

The second year is devoted to German reading and translation, gradually leading to translations of German technical works on scientific and engineering subjects. Both text-books and current German scientific periodicals are used.

University Engineering Society.

This organization was formed by the students of the engineering department in October, 1911. The purpose of the organization is partly social and partly educational. At stated intervals, topics of special interest to students of engineering are presented and informally discussed. The principal aim of the society, however, is to bring the students closer together, and to establish between them the bonds of good fellowship and fraternity.

William T. Crowe, President; Clarence Glaser, Vice-President; Will Grover Streeter, Secretary; Quenby Reno, Censor.

DIRECTORY.

The President, William F. Dooley,
University of Detroit, Detroit, Michigan.

The Dean, College of Arts,
University of Detroit, Detroit, Michigan.

The Dean, College of Engineering,
University of Detroit, Detroit, Michigan.

The Dean, College of Law,
University of Detroit, Detroit, Michigan.

The Dean, Evening Courses,
University of Detroit, Detroit, Michigan.

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1913/14

University of Detroit

BULLETIN

Announcement of
Co-Operative Engineering Courses

1913-1914

University of Detroit

BULLETIN

Announcement of Co-Operative Engineering Courses

1913-1914

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1913-14

Faculty

William F. Dooley, S. J.,
President of the University.

J. R. McColl, B. S.,
Dean.

Aloysius F. Heitkamp, S. J.,
Professor of Chemistry and Mathematics.

Louis A. Offer, B. M. E.,
Professor of Drawing and Mechanical Engineering.

John B. Kremer, S. J.,
Professor of Physics.

John B. Froebes, S. J.,
Professor of Mathematics.

E. Lewis Hayes, B. S.,
Supervisor of Shop-work and Co-ordination.

Joseph Schnitzler,
Professor of German and English.

Alanson Partridge Brush,
Lecturer on Gas and Steam Engines.

ALEXANDER DOW,
Lecturer in Electrical Engineering.

GEORGE J. LIEBER,
Lecturer on "Accident Prevention, Its Relationship to the Cost of Insurance."

THOMAS F. MCCRICKETT, C. E.,
Lecturer in Civil Engineering.

FREDERICK MARION ODENA, JR.,
Lecturer on Power Plant Construction.

ALLAN A. TEMPLETON,
Lecturer in Shop Management.

WILLIAM H. MCGREGOR,
JOHN H. WELLER,
CHARLES H. GIFFORD,
Special Lecturers.

E. A. WERBER,
Registrar.

General Statement.

This institution was incorporated April 27, 1881, according to the general law of the State of Michigan under the corporate title of "Detroit College," with power to grant such literary honors and confer such degrees as are usually conferred by similar colleges and institutions of learning in the United States. On January 10, 1911, the corporate title was changed to that of

"UNIVERSITY OF DETROIT."

The University buildings are located on Jefferson Avenue, less than one-half mile from the heart of the city and easily accessible to all street car lines.

ENGINEERING COURSE.

The course in engineering offered by the University of Detroit differs from the usual courses in engineering by following what is known as the co-operative plan, whereby the university works in direct contact with the manufacturing plants of the city,—namely, the student spends alternate weeks in the class-room and in the shops.

This departure is a result of the realization of the fact that industrial education, given in direct contact with the environments where it is afterwards to be applied, will train more efficient and skillful engineers than a course in which the practical application of the theories of the class-room is principally confined to the shops and laboratories of the university. The course, therefore, makes theory and practice go hand in hand. The student, during his course, covers all the subjects which are taught in approved engineering schools, while he is experiencing the practical side of his profession in the field where that profession is later to be exercised.

There is no longer question of the practicability of this plan. Experience has already proven it both here and in other industrial centers. Wherever students are employed in the shops under the co-operative plan, manufacturers have given their approval of the system and have been ready to accommodate in their plants a great number of such students.

The students find the combination of practical work and theory less of a strain, and derive more benefit from the plan than by continuous application to class-room work.

Located as the school is, in a great industrial center, it is easy to understand how experience in every possible variety of engineering work is open to the student. The list of co-operating plants which may be found on another page of this announcement, shows plainly how ample are the possibilities of learning in actual practice the principles of mechanical, electrical and civil engineering.

CO-OPERATIVE SYSTEM.

The co-operative system of combining the theory and practice is carried on as follows:

The student is placed at work in a machine shop, drafting room, or with a surveying or construction party,—depending on the course he has chosen,—for about half of the time allotted to the course, while the other half is spent in the university class-room.

The system is put into practical operation by dividing the class into two equal sections. One section is placed at work in the shops (the term "shops" in this bulletin means the place of the student's practical employment) and the other section takes up its work in the class-room. At the end of each week the sections are reversed. To every position in the shops, two students are assigned. In this way the employer's machine and equipment, allotted to the co-operative students, are in constant use.

These shop positions at the co-operating plants are secured by the university and belong to the university,—thus the students are relieved of all responsibility of securing positions for themselves. This arrangement relieves the student of all care and uncertainty in seeking employment, and enables the university to grade the student's work at the shops.

ADVANTAGES OF THE PLAN.

Experience is showing more clearly every day that in the training of an engineer the practical side of his profession should be strongly emphasized. The profession is nothing, if not practical. For this reason, it is not sufficient to confine the student's time and energy to the analysis of mathematical and scientific theories and the explanation of principles governing the different departments of engineering, but his training must be in the field of practical application of theory. The laboratory has failed in the past to impart the full training requisite for the engineer.

The need of this practical training is openly acknowledged by deans and professors of engineering schools throughout the country. They usually advise their students to don the overalls immediately after graduation. Whatever the reason may be, this advice is not usually followed and we oftener find engineering graduates in the drafting room or business office rather than in the machine shop or on the girders of a bridge or building. In our system work in mechanical, civil and electrical construction is part and parcel of the course.

A second advantage consists in the fact that the positions held by the students pay from 10 to 25 cents an hour, depending upon the efficiency of the student, thus enabling him to pay part of his expenses. Therefore a student can defray his expenses while at school to the extent of from $14.00 to $25.00 per month. When calculated at the end of the school-year, it will be found that a student has earned at the shops enough to cover the expenses of tuition, matriculation, laboratory fees and books.

A third advantage is that a student need not complete an entire engineering course only to discover when he has worked for awhile in some field of engineering that he has adopted a profession not in keeping with his tastes and ability. By the co-operative arrangement it is possible for the student to come very early to a conclusion, because he immediately finds himself under actual working conditions and is thrown into contact with practical engineers.

A fourth advantage consists in the fact that the student has the opportunity to display before employers whatever talent and ability he may possess, and thus it is made easier for him to find employment after graduation. Often students are offered positions early in their course, and can begin, even in the first or second year, to specialize in the theory requisite for those positions.

A fifth advantage is the fact that the student is working from eight to ten hours a day with a class of men who do the detail work in engineering operations. He learns habits of industry that will prove invaluable, and he gets a view of work from the shop-man's standpoint.

CO-OPERATING PLANTS.

The following are the plants co-operating with the University of Detroit. Others will be added as the necessity demands.

American Blower Company
American Car & Foundry Co.
American Pattern Works
Burroughs Adding Machine Co.
Detroit Shipbuilding Co.
Detroit Stove Works
Detroit Twist Drill Co.
Detroit United Railway
Edison Illuminating Co.
Federal Motor Truck Co.
Fulton-National Brass Co.
General Motors Company
Great Lakes Engineering Co.
Harrigan and Reid Co.
Lauer Machine Co.
Michigan Central Railroad Co.
Michigan State Telephone Co.
Michigan Stove Works
National Twist Drill Co.
Northern Engineering Works

Packard Motor Car Co.
Parke, Davis and Co.
Partlan, James W., Co.
Peninsular Stove Works
Russel Wheel and Foundry Co.
Schultz, A. W.
Solvay Process Co.
United States Tire Co.

In securing the co-operation of the foregoing companies the university has been careful to select those plants where a general class of work is carried on. It has favored machine shops that require the skilled machinist, rather than the machine hand who repeats over and over again certain operations. An examination of the list will disclose the 'fact that plants have been favored which turn out large units, such as cranes, steam engines and heating systems, and also those which have machine shops for the manufacture and repair of their own equipment.

When assignments are made to plants engaged in turning out a great number of the same product, such as an adding machine or automobile, arrangements are made whereby the student is shifted from machine to machine and from department to department as fast as he learns the operations. Railroads in and about Detroit, construction companies, electrical plants and power houses, each in its own particular line of engineering, give ample opportunities to the earnest student to specialize in civil or electrical engineering.

CO-ORDINATOR.

The shop department is under the supervision of a co-ordinator, who is a graduate engineer and a journeyman mechanic. He divides his time between the shop and the university. He makes the rounds of the shops where the students are employed and familiarizes himself with the conditions, and keeps an accurate record of each student's progress. At the university he presides over what is known as the co-ordination class, where shop problems are discussed. Furthermore, his duty is to act in an advisory capacity to the professors of mechanics, mechanisms, machine design, strength of materials, etc., in order that problems which the students have encountered in their practical experience may receive more detailed exposition.

REQUIREMENTS FOR ADMISSION.

Candidates for admission must be at least sixteen years of age. They must either present a certificate of graduation from an accredited high school, or give evidence of having satisfactorily completed an amount of preparatory study represented by fifteen units, as explained below. A unit is understood to mean one full school year of five recitations per week.

The units presented must include the following:

English	3 units
Algebra (through Quadratics)	1 unit
Geometry, Plane	1 unit
Geometry, Solid	½ unit
Physics	1 unit
History	1 unit
Language	1½ units
	9 units

The remaining six units may be selected from the following list:

Manual Training	2 units	Chemistry	1 unit
Drawing	1 or 2 units	Trigonometry	½ unit
Civics	½ unit	German	2 units
History	1 unit	French	2 units
Astronomy	½ unit	Spanish	1 unit
Geology	½ unit	Latin	2 units
Physical Geography	½ or 1 unit	Greek	2 units
		English	1 unit

Candidates for admission who have no deficiencies should fill out entrance blanks, (which may be obtained from Registrar) and have them signed by the principal of the school where credits were earned.

Those who have deficiencies must have their entrance blanks in the office of the university by August 15th.

Examinations for admission will be held from August 25th to August 30th.

Students who lack credits in subjects other than Algebra through Quadratics, Plane and Solid Geometry may enter the regular course on condition that they make up lacking credits during the first year.

If a diploma is not presented, evidence of honorable dismissal must be given from the preparatory school or college last attended.

MATRICULATION.

Matriculation in the engineering department may be made between July 1st and September 2nd. Candidates who decide to enter this department should communicate with the dean of the department as early as possible. They should make an exact statement as to fitness to satisfy entrance requirements. The university wishes applicants to enroll as soon as possible, in order to give them some weeks of practical experience at the shops before the opening of classes. Candidates who enter early, not only have the benefit of more shop experience, but the additional advantage of securing better positions.

Special Students: Persons wishing to do university work in engineering will be admitted to lectures and shops as special students on payment of special fee. Should such students afterwards desire to apply for a degree, they must first satisfy all the entrance requirements.

Advanced Standing: Candidates who have successfully carried on any of the subjects given in this course may apply for advanced standing to the professor in charge of that particular course. Application for advanced standing should be made within the first three class weeks of each semester.

DEGREES.

The degree of Bachelor of Civil Engineering, (B. C. E.) Bachelor of Mechanical Engineering, (B. M. E.) and Bachelor of Electrical Engineering, (B. E. E.) will be given to students who have satisfactorily completed the five year course mapped out on the following pages.

TERMS IN THE ENGINEERING COURSE.

A matriculation fee of $5.00 is paid by all students of the university before entering upon any course and entitles them to permanent membership in the university.

Regular students in the engineering department pay an annual tuition fee of $100.00, payable in two equal installments before the beginning of each semester.

Students entering before the beginning of the first semester, (Sept. 22nd) must pay their matriculation fee and $25.00 (one-half of the first semester's tuition) before taking up their shop-work. The remaining $25.00 must be paid at the beginning of the semester, Sept. 22nd.

Special students will be charged a fee of $3.00 per credit. A credit, as explained later, is the equivalent of one class period per week for one semester. The credit value of each course is given in the schedule of studies.

A laboratory fee of $5.00 will be charged for each semester's course in the physical, chemical, mechanical, civil and electrical laboratories.

A small deposit for breakage will also be required in these courses.

GENERAL REGULATIONS.

The enrollment card filled out at the time of enrollment must be revised when necessary. Notice of change of address, telephone number, course desired, etc., must be given at the office as soon as possible.

Unit of Credit: The unit of credit is one hour of class recitation, two hours of laboratory or three hours of drawing period per week for one semester. The credit value of each course is given under schedule of studies.

Absence from Class: Tardiness and absence must be accounted for to the head of the department in which it occurs. If he deem the excuse admissible, he will give him an opportunity to make up time lost; if not, five points will be deducted from the student's credits.

Absence from Shop: If absolutely unavoidable, absence from shop should be reported at once to the co-ordinator, (Cherry 4666), and also to the foreman of the shop, if possible. Avoidable absence from shop will not be tolerated, as it reflects upon the good name of all the students in the shops.

Discipline in Shop: A student while in the shop is subject to the rules and regulations of the shop. His behavior there, not only reflects seriously on the university, but determines his success in the course.

Notice of Discontinuance of Course: A student, upon enrolling into this department, does so on the condition that in case he decides to discontinue his course, he will notify the authorities of the university at least one week in advance. The week's notice is necessary so that the resultant changes in the shops can be made without disturbing the factory arrangements. Failure to serve this notice forfeits the student's right to an honorable dismissal. Withdrawal during the semester means loss of all credits for work done that semester. No fees are refunded.

Standings: Records of the examinations and class-work will be kept and recorded:

A	means	Excellent	90-100
B	"	Good	80- 90
C	"	Fair	70- 80
D	"	Conditioned	55- 70
E	"	Failed	0- 55

Conditions (D) must be removed before the beginning of the next semester. Failure (E) means student must repeat the course before he can go to advanced work in the same department.

Courses Offered.

As will be noted from the appended schedule of studies, three complete engineering courses are offered, Mechanical, Civil and Electrical.

For the first two years the studies are common to all courses, so that the student need not determine upon the particular branch until the end of his second year. The following brief synopsis of each course will help the student to make an intelligent choice.

MECHANICAL ENGINEERING.

Besides the fundamental sciences common to all branches of engineering, this course offers special opportunities in steam and gas engineering, and power-plants.

The work, special to this branch, includes the designing of steam and gas engines and steam turbines, and a study of methods of power distribution and application by both mechanical and electrical means. Complete power-plant designs are made both for the generation of electrical power and for direct use in manufacturing plants, and students become familiar with all forms of steam, gas, and electrical machinery through their study and operation in the course at the university and in the shops. This course also includes the designing of shops, traveling cranes and power distribution systems. The course is intended to train production engineers and managers of manufacturing plants of all kinds.

CIVIL ENGINEERING.

The first aim is to impart as broad a scientific training as the length of the course and the essential professional studies will allow, so that as many avenues to successful service as possible may be open to the graduate. Along professional lines, emphasis is laid first, on work in surveying and field methods, as these are of special value to civil engineers; second, on mechanics and its applications to the design of roofs, bridges and other structures; third, on the theory and practice of re-enforced concrete construction; fourth, on railway location and construction; fifth, on sanitary and municipal engineering, including water supply, sewerage, roads and pavements.

A specialized course in bacteriology, particularly in its relation to water supply and sewerage, a broad and general study of sanitary science as related to public health problems, courses in the design of engineering structures related to sewage disposal and water purification. Stress is placed on the study of principles as being the things not likely to be acquired in after-life.

ELECTRICAL ENGINEERING.

The course of Electrical Engineering is designed to train the student in the building of power-plants; in the electrification of shops, tunnels, railroads, cities; in the transmission and distribution of power, in telephoning, and wireless telegraphy. The co-operative plan of engineering calls for a wide and varied experience in practical electrical work. The aim of the entire course is to develop in the student those qualities which are essential to the engineer, as well as those that are essential to the electrical artisan.

Schedule of Studies.

MECHANICAL ENGINEERING.

FIRST SEMESTER—FRESHMAN YEAR.

Subject.	Course.	Hours.	Credits.
Trigonometry	Math. 1	6	6
Chemistry	Ch. 1	4	4
Chemistry, Laboratory	Ch. 1a	6	3
Drawing	M. E. 1	9	3
Co-ordination	C. 1	2	2
English	Eng. 1	2	2
German	Ger. 1	3	3
		32	23

SECOND SEMESTER—FRESHMAN YEAR.

Subject.	Course.	Hours.	Credits.
College Algebra	Math. 2	6	6
Chemistry	Ch. 2	4	4
Chemistry, Laboratory	Ch. 2a	4	2
Descriptive Geometry, Recitation	M. E. 2	3	3
Descriptive Geometry, Drawing	M. E. 2a	9	3
Co-ordination	C. 2	2	2
English	Eng. 2	2	2
German	Ger. 2	3	3
		33	25

FIRST SEMESTER—SOPHOMORE YEAR.

Subject.	Course.	Hours.	Credits.
Analytical Geometry	Math. 3	6	6
Physics (Heat and Light)	Physics 1	4	4
Physics, Laboratory	Physics 1a	6	3
Co-ordination	C. 3	2	2
Qualitative Analysis	Ch. 3	1	1
Qualitative Analysis, Laboratory	Ch. 3a	6	3
English	Eng. 3	2	2
German	Ger. 3	3	3
		30	24

SECOND SEMESTER—SOPHOMORE YEAR.

Subject.	Course.	Hours.	Credits.
Differential Calculus	Math. 4	6	6
Physics (Mechanics and Sound)	Physics 2	4	4
Physics, Laboratory	Physics 2a	6	3
Co-ordination	C. 3	2	2
Mechanisms	M. E. 3	5	5
Mechanisms (Drawing)	M. E. 3a	6	2
English	Eng. 4	2	2
German	Ger. 4	3	3
		34	27

FIRST SEMESTER—PRE-JUNIOR YEAR.

Subject.	Course.	Hours.	Credits.
Integral Calculus	Math. 5	6	6
Physics (Electricity and Magnetism)	Physics 3	4	4
Physics, Laboratory	Physics 3a	6	3
Machine Drawing	M. E. 4	9	3
Steam Engines	M. E. 5	5	5
Metallurgy	Ch. 6	2	2
Co-ordination	C. 4	2	2
		34	25

SECOND SEMESTER—PRE-JUNIOR YEAR.

Subject.	Course.	Hours.	Credits.
Mechanics	Math. 6	6	6
Surveying, Recitation	C. E. 4	1	1
Surveying, Field Work	C. E. 4a	6	3
Co-ordination	C. 5	2	2
Structural Mechanics	C. E. 1	5	5
Economics		2	2
Electrical Engineering	E. E. 1	4	4
Electrical Engineering, Laboratory	E. E. 1a	6	3
		32	26

FIRST SEMESTER—JUNIOR YEAR.

Subject.	Course.	Hours.	Credits.
Strength of Materials	C. E. 2	5	5
Machine Design	M. E. 8	5	5
Electrical Engineering	E. E. 2	4	4
Electrical Engineering, Laboratory	E. E. 2a	4	2
Machine Design (Drawing)	M. E. 9	6	2
Valve Gears	M. E. 6	3	3
Co-ordination	C. 6	2	2
		29	23

SECOND SEMESTER—JUNIOR YEAR.

Subject.	Course.	Hours.	Credits.
Machine Design	M. E. 10	9	3
Thermodynamics	M. E. 11	5	5
Hydraulics	C. E. 3	4	4
Trips of Inspection		2	1
Economics		3	3
Heating and Ventilating	M. E. 20	3	3
English (Public Speaking)	Eng. 5	2	2
Co-ordination	C. 7	2	2
		30	23

FIRST SEMESTER—SENIOR YEAR.

Subject.	Course.	Hours.	Credits.
Steam Laboratory	M. E. 7	8	4
Steam Turbines	M. E. 18	3	3
Hoisting Machinery	M. E. 12	9	3
Gas Engines	M. E. 14	3	3
Hydraulic Machinery	C. E. 7	3	3
English	Eng. 6	2	2
Economics		3	3
		31	21

SECOND SEMESTER—SENIOR YEAR.

Subject.	Course.	Hours.	Credits.
Steam Laboratory	M. E. 13	8	4
Marine Engineering	M. E. 19	3	3
Power Plants	M. E. 15	3	3
Gas Engine Design	M. E. 16		
or			
Automobile Design	M. E. 17	8	4
Thesis		6	6
		28	20

CIVIL ENGINEERING.

FIRST SEMESTER—PRE-JUNIOR YEAR.

(Freshman and Sophomore Years same as Mechanical Engineering.)

Subject.	Course.	Hours.	Credits.
Integral Calculus	Math. 5	6	6
Physics (Electricity and Magnetism)	Physics 3	4	4
Physics, Laboratory	Physics 3a	6	3
Topographical Drawing	C. E. 5	9	3
Steam Engines	M. E. 5	5	5
Metallurgy	Ch. 6	2	2
Co-ordination	C. 4	2	2
		34	25

SECOND SEMESTER—PRE-JUNIOR YEAR.

Subject.	Course.	Hours.	Credits.
Mechanics	Math. 6	6	6
Surveying, Recitation	C. E. 4	1	1
Surveying, Field Work	C. E. 4a	6	3
Structural Mechanics	C. E. 1	5	5
Economics		2	2
Electrical Engineering	E. E. 1	4	4
Electrical Engineering, Laboratory	E. E. 1a	6	3
Co-ordination	C. 5	2	2
		32	26

FIRST SEMESTER—JUNIOR YEAR.

Subject.	Course.	Hours.	Credits.
Strength of Materials	C. E. 2	5	5
Electrical Engineering	E. E. 2	4	4
Electrical Engineering, Laboratory	E. E. 2a	4	2
Geology		3	3
Mineralogy		3	3
Co-ordination	C. 6	2	2
Surveying	C. E. 6	6	3
		27	22

SECOND SEMESTER—JUNIOR YEAR.

Subject.	Course.	Hours.	Credits.
Surveying	C. E. 8	8	4
Hydraulics	C. E. 3	4	4
Framed Structures	C. E. 9	5	5
Economics		3	3
English (Public Speaking)	Eng. 5	2	2
Trips of Inspection		2	1
Electives		2	2
Co-ordination	C. 8	2	2
		28	23

FIRST SEMESTER—SENIOR YEAR.

Subject.	Course.	Hours.	Credits.
Gas Engines	M. E. 14	5	5
Hydraulic Machinery	C. E. 7	3	3
English	Eng. 6	2	2
Economics		3	3
Cement Theory	C. E. 10	3	3
Civil Engineering, Laboratory	C. E. 11	6	3
Structural Design	C. E. 12	9	3
		31	22

SECOND SEMESTER—SENIOR YEAR.

Subject.	Course.	Hours.	Credits.
Power Plants	M. E. 15	3	3
Municipal Engineering	C. E. 13	5	5
Engineering Design	C. E. 14	9	3
Sanitary Engineering	C. E. 15	2	2
Thesis		6	6
		25	19

ELECTRICAL ENGINEERING.

FIRST SEMESTER—PRE-JUNIOR YEAR.

(Freshman and Sophomore Years same as Mechanical Engineering.)

Subject.	Course.	Hours.	Credits.
Integral Calculus	Math. 5	6	6
Physics (Electricity and Magnetism)	Physics 3	4	4
Physics, Laboratory	Physics 3a	6	3
Machine Drawing	M. E. 4	9	3
Steam Engines	M. E. 5	5	5
Metallurgy	Ch. 6	2	2
Co-ordination	C. 4	2	2
		34	25

SECOND SEMESTER—PRE-JUNIOR YEAR.

Subject.	Course.	Hours.	Credits.
Mechanics	Math. 6	6	6
Surveying, Recitation	C. E. 4	1	1
Surveying, Field Work	C. E. 4a	6	3
Structural Mechanics	C. E. 1	5	5
Economics		2	2
Electrical Engineering	E. E. 1	4	4
Electrical Engineering, Laboratory	E. E. 1a	6	3
Co-ordination	C. 5	2	2
		32	26

FIRST SEMESTER—JUNIOR YEAR.

Subject.	Course.	Hours.	Credits.
Strength of Materials	C. E. 2	5	5
Electrical Engineering	E. E. 2	4	4
Electrical Engineering, Laboratory	E. E. 2a	4	2
Electrical Design	E. E. 4	9	3
Telephones	E. E. 9	2	2
Machine Design	M. E. 8	5	5
Co-ordination	C. 6	2	2
		31	23

SECOND SEMESTER—JUNIOR YEAR.

Subject.	Course.	Hours.	Credits.
Electrical Machinery	E. E. 3	5	5
Electric Power Transmission	E. E. 5	3	3
Hydraulics	C. E. 3	4	4
Economics		3	3
English (Public Speaking)	Eng. 5	2	2
Trips of Inspection		2	1
Co-ordination	C. 9	2	2
		21	20

FIRST SEMESTER—SENIOR YEAR.

Subject.	Course.	Hours.	Credits.
Steam Turbines	M. E. 18	3	3
Economics		3	3
English	Eng. 6	2	2
Illumination	E. E. 10	3	3
Electrical Laboratory	E. E. 11	8	4
Electrical Design	E. E. 6	9	3
Electives		3	3
		31	21

SECOND SEMESTER—SENIOR YEAR.

Subject.	Course.	Hours.	Credits.
Power Plants	M. E. 15	3	3
Electrical Design	E. E. 8	6	2
Electrical Railroads	E. E. 7	2	2
Electives		6	6
Thesis		6	6
		23	19

Description of Studies.

MECHANICAL ENGINEERING.

M. E. 1. Elementary Drawing:—Use of instruments, lettering, geometrical figures, elementary projections, difference between first and third angle projections and drawing room standards. The drawing room standards include methods of dimensioning, cross sectioning, and representing screw threads, bolts, nuts, etc. Some time is spent in tracing and blue printing. Great care is exercised in this course to give the student a knowledge of the best practice used in the most modern drafting rooms.

M. E. 2. Descriptive Geometry:—By means of orthographic projections; points, lines, and surfaces in space are represented accurately upon a single plane, i. e., the drawing plate. A thorough study is made of the different kinds of surfaces, such as plane, single curved, double curved and warped surfaces, with tangent, normal and intersecting planes. Lines of intersection and developments are considered at length. This course includes recitations, lectures and drawing periods.

M. E. 3. Mechanisms:—Investigation of the laws of kinematics. Solution of problems by means of instant centers, designing of cams, gears, linkage, etc. Recitations, lectures and drawing periods.

M. E. 4. Machine Drawing:—Continuation of M. E. 1 with special emphasis placed upon making practical working drawings of machine parts. The method employed is that of making free-hand sketches from which the detail drawing is made. From the detail drawings, assembly drawings are made, thus checking their completeness.

M. E. 5 Steam Engines:—The principal power-producing machines are here studied, but principally the steam boiler and engine, and the gas producer and gas engine. Considerable time is given to the steam turbine.

M. E. 6. VALVE GEARS:—A study of the various kinds of valves used on steam and gas engines is taken up. A study is made of the Zeuner and Bilgrim diagrams with problems applied to steam valves. Considerable time is given to the study of the Stephenson, the Walschaert and the Joy Valve Gears. Governors are also considered.

M. E. 7. MECHANICAL LABORATORY:—The aim in this course is to give the student actual practice in the use of steam engine testing apparatus. With this in view they are taught to calibrate steam engine indicators, themometers, gauges, etc. The determination of the calorific value of coal, gas and oil is also taken up. The students' services as helpers will be offered to engineers in the city who are making tests on plants of all descriptions.

M. E. 8. MACHINE DESIGN, THEORETIC:—This is a course in which the theory taken up in C. E. 1 and 2 is used in designing machine parts. These parts include bolts, journals, shafts, pulleys, gears, connecting and piston rods, and frame works of machines. Recitations and lectures only.

M. E. 9. MACHINE DESIGN, DRAWING:—The design of boiler and steam engine parts is worked out carefully in the drawing room. This course gives the student ample opportunity to apply the principles learned in M. E. 8. As in all other drawing courses, reliable and practical working drawings are insisted upon.

M. E. 10. MACHINE DESIGN, TOOLS:—Design of jigs, fixtures, and other machine tools.

M. E. 11. THERMODYNAMICS:—In this course a study is made of the properties of gases and vapors under different conditions, as applied to the steam and gas engine, air compressor and refrigerating machine.

M. E. 12. HOISTING MACHINERY:—The object of this course is to give the student an opportunity to apply the theory of M. E. 8 to a structural machine,—the design of columns, girders, ropes and sheaves is included.

M. E. 13. Steam Laboratory:—Some of the time allotted to this course will be spent in the university laboratory, but the course consists principally in testing engines, turbines, boilers, etc., in plants about the city.

M. E. 14. Gas Engines:—This is a course of lectures and recitations covering the various types of gas engines. It includes a study of gas engine operation, testing and installation.

M. E. 15. Power Plants:—The arrangements, size and cost of the various units that are necessary in laying out a power house are here studied. Specifications for steam plants are also taken up.

M. E. 17. Automobile Design:—The principal parts that go into the automobile are carefully laid out, and working drawings made.

M. E. 18. Steam Turbines:—This course consists of lectures, recitations and problems covering the theory and construction of steam turbines. It includes a study of the principal points of both impulse and reaction turbines, such as nozzles, blades, etc., along with the commercial types. Efficiency and adaptability of turbines, as compared with other power producers, is an important feature.

M. E. 19. Marine Engineering:—A brief study is made of the engineering equipment of ships, such as types of engines, boilers, condensers, screws, paddle wheels, etc. The lake steamers will be considered principally.

M. E. 20. Heating and Ventilating:—In this course a study is made of the methods employed in heating and ventilating residences, shops and offices. The various kinds of heating systems, as hot water, direct and indirect steam, and hot air, are studied. Typical plants in the city are inspected and discussed. Lectures will be given by prominent engineers.

CIVIL ENGINEERING.

C. E. 1. Structural Mechanics:—In this course the theoretical principles of mechanics are applied to engineering structures. These include the determination of the stresses in the members that go to make up the roof trusses, bridges, arches, etc., the location of the centers of inertia, and the findings of the radii of gyration of cross-sections. Plotting of bending moment and shear diagrams is also covered.

C. E. 2. Strength of Materials:—The various properties of materials are studied to determine their ability to resist the stresses investigated in C. E. 1. The resisting moment of the materials in various shapes, such as common steel sections and timber and reinforced concrete beams. Pieces in compression, such as columns, posts and struts are investigated by means of Schneider's and Worster's formulae. Internal stresses in structural pieces are analyzed.

C. E. 3. Hydraulics:—In this course a study is made of the performance of water in its many applications to engineering work. This considers its flow through pipes, channels and orifices, and over weirs. Losses by friction in pipes is an important item. Practical problems in hydro-electrical plants are also discussed.

C. E. 4. Surveying:—One hour a week is given to lecture or quiz in the use of surveying instruments and methods of making surveys. It includes the reading of instruments, measuring distances and angles, staking out, measuring and computing traverses, running levels, making profiles and platting.

C. E. 4a. Surveying Field Work:—The class is divided into squads and detailed to different parts of the city to make the surveys, run sets of levels, etc.,—thus becoming perfectly familiar with the instruments and methods employed in surveying. The work in the field is carefully computed and tabulated in a field note-book.

C. E. 5. Topographical Drawing:—This course consists of a study of the practice in the conventional methods of representing topography, together with the platting of the results of field practice in connection with surveying. A complete map of a section in the city is required of each student.

C. E. 6. SURVEYING:—This course is required only of Civil Engineering students, and is part review and part extension of C. E. 4. Besides the subjects mentioned in that course, railroad curves, earthwork surveys and city platting is taken up.

C. E. 7. HYDRAULIC MACHINERY:—Water turbine theory and practice are studied along with other water power station machinery.

C. E. 8. RAILROAD SURVEYING:—In this course complete surveys are made for sections of both street and steam railroads. Curves, etc., of track already laid are surveyed and checked with theory given in text-books. The setting out of simple and compound curves and calculation of excavations and embankments. Yards, turnouts, and switches. Easement curves of various types. Calculation of water-ways, and methods of staking out foundations for culverts and bridges. Some time may be spent with the surveying parties of the railroads in the city.

C. E. 9. FRAMED STRUCTURES:—In this course an investigation is made of the stresses in trusses, arches, draw spans, etc. It applies the theory of C. E. 1 to specific problems. Various styles of trusses are studied and their members analyzed.

C. E. 10. CEMENT THEORY:—The use of cement in the building of reinforced concrete structures, and solid cement work is studied. The extensive use of this material in buildings of all description makes this course of great importance. Practical examples are worked out. Part of the course will be given over to lectures by prominent engineers.

C. E. 11. CIVIL ENGINEERING, LABORATORY:—Torsion, compression, bending and shearing tests of timber, metals and concrete are carried on, and checked with the theory given in C. E. 1 and 2.

C. E. 12. STRUCTURAL DESIGN:—A complete framed structure is designed, and working drawings made. Here, as in all other designing courses, practical working drawings are insisted upon.

C. E. 13. Municipal Engineering:—Construction of sewers, streets, pavements, etc., and their locations in cities, are taken up. This course will consist principally of lectures given by experts engaged in this work.

C. E. 14. Engineering Design:—In this course further practical application of the theoretical problems is made. It includes some complete structure, such as power building, mill, or small office building. As in all other drawing courses the plates must be practical working drawings.

C. E. 15. Sanitary Engineering:—A broad and general view of the large body of sanitary science upon which the modern practice of sanitation is based. The effects of good practice in such matters as public water supply, sewerage and drainage, state and federal control over the pollution of streams, the elimination of dust and mud and snow from city streets, and the ventilation of public buildings. The course will consist mostly of lectures by prominent engineers.

ELECTRICAL ENGINEERING.

E. E. 1. Direct Current Machinery:—In this course a partial review of that part of physics which deals with electricity is first taken up. This is followed by a careful study of the direct current motor, generator, the storage battery, etc. On account of the important part that electricity now plays in nearly every engineering project, this course is required of all students, and is made very thorough. The course consists of lectures, problems and recitations.

E. E. 1a. Direct Current, Laboratory:—Actual tests are made to determine the efficiency, performance, etc., of various types of direct current machines.

E. E. 2. Alternating Current Machinery:—The object of this course is to give the student a fair understanding of the alternating current and its many important applications. The motor, generator, converter, mercury arc rectifier and transformer are studied in detail.

E. E. 2a. ALTERNATING CURRENT MACHINERY, LABORATORY:—Tests are made upon the various machines, both in the university laboratory, and in the power plants of the city.

E. E. 3. ELECTRICAL MACHINERY:—This course reviews courses E. E. 1 and 2, and takes up in greater detail the machines studied therein. Special study is made of the theory of the alternating current and its application. Operation of electrical machinery is an important item.

E. E. 4. DIRECT CURRENT ELECTRICAL DESIGN:—In this course the complete design is made of a direct current motor and an electro-magnet. Practical working drawings are insisted upon.

E. E. 5. ELECTRIC POWER TRANSMISSION:—The central electrical station, and long distance transmission lines are studied.

E. E. 6. ALTERNATING CURRENT ELECTRICAL DESIGN:—This course is similar to E. E. 4, but considers only alternating machines, such as transformers, converters, etc.

E. E. 7. ELECTRICAL RAILROADS:—The aim here is to give the student a fair idea of the solution of the principal problems met in electrical railroads. These include the determination of power required by trains, methods of electrical transmission, arrangement of schedules, etc.

E. E. 8. ELECTRICAL DESIGN:—The electrical part of the installation of a modern power house is designed. Details of the switchboards, conduits, generators and motor settings are made.

E. E. 9. TELEPHONES:—A study is made of the theory of the electrical transmission of speech. Long distance and local systems are investigated. Time is given to the inspection of central stations, and wherever possible, lectures by telephone experts are given.

E. E. 10. ILLUMINATION:—A study is made of the theory of illumination, and the practical methods employed in furnishing light for streets and buildings.

E. E. 11. Electrical Laboratory:—Advanced experiments with electrical machinery, and the testing of machines. As far as possible these tests will be made in the electrical plants of the city.

MATHEMATICS.

1. Trigonometry:—Definitions and relations of trigonometric functions; logarithms; solution of trigonometric equations. Determination of sides, angles and areas of right and oblique triangles in both plane and spherical trigonometry. Some time is given to practice in the use of both logarithmic and trigonometric tables, and solution of original problems.

2. Advanced Algebra:—Review of surds, imaginaries and quadratic equations and their geometrical representation. Special study is made of binomial theorem, permutations and combinations, and convergence and divergence.

3. Analytical Geometry:—The object of this course is to familiarize the student with analytical methods of investigation; representation of the straight line, circle, parabola, ellipse and hyperbola by means of equations. A short time is devoted to solid analytic geometry.

4. Differential Calculus:—A very thorough course in differential calculus is given, including variables, functions and limits, differentiation, maxima and minima, radii and centers of curvature and tracing of curves.

5. Integral Calculus:—Methods of integration as applied to finding of areas, volumes, length of curves, and moments of inertia.

6. Mechanics:—This course brings together all the principles of physics and mathematics that have a direct bearing on the purely engineering subjects which follow it in the course. It takes up the laws of motion, such as momentum, force and energy. Parallel and concurrent forces, statics, principles of work, rectilinear and curvilinear motion, and finally centers of inertia and radii of gyration are very carefully considered.

CHEMISTRY.

1. Elementary Inorganic Chemistry:—A study of the occurrence, preparation, physical and chemical properties of metals and non-metals. Their use and application in the arts. Symbols and equations. Laws of definite and multiple proportion. Equivalent, molecular and atomic weights. Oxidation, reduction, decomposition, dissociation, ionization and hydrolysis.

2. Inorganic Chemistry:—A thorough study of metals and non-metals, their classification, their use in engineering problems. Kinetic molecular hypothesis. Theory of solution and dissociation. Colloids, hydrosols and hydrogels. Chemical equilibrium, ionization and the interaction of ionic substances. Ionic theory of precipitation and solution, complex ions.

1a and 2a. Chemical Laboratory:—A selection of experiments will enable the student to familiarize himself with the elements and compounds, but especially fit him to attack the problems that may present themselves to the practical engineer.

3. Qualitative Analysis:—Analytical actions, separations and identifications in the light of modern theories of ionic solution and equilibrium.

3. Qualitative Laboratory:—In the laboratory, selected reactions and separations which exercise the observational and reflective powers of the student, whilst giving the technical knowledge necessary to discover the constituents of simple alloys, ores and minerals.

4. Quantitative Analysis:—Determination of exact amount of each of the different constituents in any compound. Gravimetric and volumetric. Elective.

5. Organic Chemistry:—Introduction to the carbon compounds and their principal derivatives. Elective.

6. Metallurgy:—Fuels and other means of obtaining high temperatures: Furnaces and their accessories. Treatment of the principal iron ores.

GENERAL PHYSICS.

Instruction in Physics is given by lectures illustrated by numerous demonstrations and by recitations 'from lessons assigned in a text-book. The object of the course is to acquaint the student with experimental facts, as well as with the quantities used in Physics and the theory and method of calculation. Particular attention is given to the fundamental principles and the solution of problems of a practical nature. A special effort is made to adapt the course to the needs of technical students. For this reason most of the time will be given to such subjects as are correlated to later technical work.

The course includes the treatment of the mechanics of solids, liquids and gases; heat, sound, light, magnetism and electricity.

Text-book: Carhart, University Physics.

Laboratory Physics: The laboratory experiments are intended to give the students,—not only a practical knowledge in the use of standard apparatus, and training in the methods of making and recording physical measurements,—but also a firmer grasp and clearer insight into the physical laws and phenomena. More stress is laid on the grasp of principles and personal resourcefulness on the part of the student than on mere skill in following a set of directions. The student is required to keep an accurate and detailed record of every experiment performed. The work required is not only accurate, but as far as possible, individual,—and great importance is laid on the discussion of the sources of error.

Experiments in the branches of the different subjects are selected from laboratory manuals of Ames & Bliss, Stewart & Gee, Miller, Millikan and others. Accurate measurements of length, mass and density, by means of comparator, cathetometer and balance; the determination of the constants of gravity, inertia, and elasticity; calorimetric measurements; the use of the spectroscope, spectrometer, polariscope, and grating; determination of the velocity and pitch of sound; magnetic and electrical measurements are among the more important exercises.

CO-ORDINATION.

C.1 to C.9: These courses consist of two class periods per week in the university. The students from the various shops are brought together into one class, and their difficulties and experiences are discussed. From time to time shop superintendents and foremen are invited to send in problems and questions arising in their daily work. These, as far as possible, are worked out by the faculty engineers and students, and the class room is made a sort of clearing house for knowledge. Whenever any subject is under consideration, such as shop management, power tranmission, routing of work, limits of accuracy, feeds and cuts of machine tools, overhead costs, time keeping systems, etc., the students discuss the methods followed in the different plants. In this way a very broad idea of the work carried on in the several shops is brought to each student.

Shop mathematics, methods of setting up and doing different operations on the machines and at the bench are studied. Tables for curves are worked out for simplifying such work as cutting tapers, threads, feeds and speeds, etc. The student will, from time to time, be expected to write reports on what he has observed in the shop, and read them before the class.

INSPECTION TRIPS.

Detroit offers great opportunity for visiting engineering plants of all descriptions. Among the works inspected are electric lighting, shipbuilding, automobile, railroad car, stove, steam engine, blower, and bridge companies. The material for many of the themes for the English courses will be taken from these trips.

ENGLISH.

FRESHMAN.

The first year's English consists of a brief review of the principles of rhetoric with special attention to the theme and paragraphic unit. Theme writing is begun at once with special emphasis upon a clear and concise expression of thought. The student is soon required to write reviews of leading articles in current scientific periodicals, the aim constantly being to obtain a natural and exact expression of thought.

One hour per week is spent in text book study, which also comprises a study of English and American masterpieces, and one hour per week is given to theme work, as noted above, throughout the freshman year. (Courses Eng. I, and Eng. II.)

Unless the student already possesses a literary education, he is also required to do a certain amount of outside reading. This reading comprises works of poetry, fiction, essays, history, biography and science.

READING REQUIRED OF FRESHMEN STUDENTS.

The following course of reading is required of all freshmen in this department. The object of the requirement is to supplement the regular class work by giving the student examples of well-rendered thought, as presented by the best writers in the several departments of literature.

Such literature, when earnestly read, will also necessarily broaden the student's knowledge and stimulate his powers of thought and expression.

Each student will read, during the academic year, as many books from the following lists as will give him a total credit of 100 points. The selection must include at least one book from each of the four lists. Students having credit in college literary work will be credited for such work and will not be required to do the full 100 points of reading.

Further instructions will be given by the instructor in first year English.

I. Science.

Fisher, Mrs. A. B.: A Short History of Natural Science, (25).
Newcomb, Simon: Astronomy for Everybody, (25).
Clerk, Agnes: History and Astronomy in the 19th Century, (25).
Walsh, J.: Thirteenth Greatest of Centuries, (20).
Norton: Elements of Geology, (20).

CHAMBERLIN AND SALISBURY: College Geology, (20).
FOURNIER: Electron Theory, (20).
SNYDER, CARL: New Conceptions in Science, (20).
FRANKLAND, P. F.: Our Secret Friends and Foes, (20).
PROCTOR, R. A.: Other Worlds Than Ours, (20); Light Science for Leisure Hours, (10).
BYRN, E. W.: Progress of Inventions in the Nineteenth Century, (20).
SHALER, N. S.: Nature and Man in America, (20); Man and the Earth, (15).
LUBBOCK, J.: The Intelligence of Animals, (15); Scientific Lectures, (20).
DUNCAN, R. K.: The New Knowledge (Radium, Etc.), (15).
THOMPSON, S. P.: Light, Visible and Invisible, (15).
RUSSELL, I. C.: Lakes of North America, (15).
ILES, G.: Flame, Electricity and the Camera, (15).
MENDENHALL, T. C.: A Century of Electricity, (15).
GERARD: Old Riddle and Newest Answer, (10).

II. HISTORY AND BIOGRAPHY.

FISKE, JOHN: American Revolution, 2 vols., (40); Discovery of America, 2 vols., (40); Beginnings of New England, (25); Old Virginia and Her Neighbors, 2 vols., (40).
GRANT, U. S.: Personal Memoirs, 2 vols., (40).
LEE, SIDNEY: Great Englishmen of the Sixteenth Century, (25).
CREASY, E. S.: Fifteen Decisive Battles of the World, (20).
RAWSON, E. K.: Twenty Famous Naval Battles, (20).
MACAULAY, T. B.: History of England, Vol. I., Chap. 3, (10).
HARCOURT, L. F.: Vernon; Achievements in Engineering, (20).
MOFFETT, CLEVELAND: Careers of Danger and Daring, (20).
COCHRANE, C. H.: Wonders of Modern Mechanism, (20).
COCHRANE, ROBERT: Romance of Industry and Invention, (20).
CHURCH, W. C.: Life of John Ericcson, (20).
SMILES, S.: Lives of George and Robert Stephenson, (20), and of Bolton and Watt, (20), in "Lives of the Engineers."
THOMPSON, S. P.: Michael Faraday, His Life and Work, (20).

THORPE, T. E.: Humphrey Davey, Poet and Philosopher, (20).
BREWSTER, SIR DAVID: Life of Sir Isaac Newton, (20).
CLERKE, MISS A. M.: The Herschels and Modern Astronomy, (20).
GLAZEBROOK, R. T.: James Clerk Maxwell, (20).
FRANKLIN, BENJAMIN: Autobiography, (10).

III. FICTION.

BULWER-LYTTON, E. L.: The Last Days of Pompeii, (25).
DICKENS, CHARLES: A Tale of Two Cities, (20); David Copperfield, (20).
SCOTT, WALTER: Woodstock, (20); Guy Mannering, (20); Kenilworth, (20); Quentin Durward, (20); Waverly, (20).
STEVENSON, R. L.: Kidnapped, (20).
HAWTHORNE, NATHANIEL: The House of Seven Gables, (20).
COOPER, J. F.: The Pilot, (20); The Spy, (20).
ALLEN, JAMES LANE: The Reign of Law, (20).
KIPLING, RUDYARD: Captains Courageous, (15).

IV. ESSAYS AND POETRY.

EMERSON, R. W.: Representative Men, (25).
LAMB, CHARLES: Essays of Elia, (25).
DANTE: Inferno, Norton's Translation, (25).
HOMER: Iliad, (25); Odyssey, (25).
CARLYLE, T.: Heroes and Hero-Worship, (20).
TENNYSON, ALFRED: In Memoriam, (20); Maud, (20).
BROWNING, R.: Pippa-Passes, (10); A Soul's Tragedy, (20); Strafford, (20).
SHAKESPEARE: Hamlet, (15); Othello, (15); Macbeth, (10); The Tempest, (10); King Lear, (10); Twelfth Night, (10).

A supplementary list will be supplied from time to time by the instructor in this department.

SOPHOMORE.

The second year continues the theme work, but a large share of the subject matter is furnished by the students' shop experiences and by inspections of the many engineering problems and constructions, which only a large city can furnish. The student is encouraged to observe and to express in scientific language what he has seen. Here also the study of English and American masterpieces is continued. (Courses Eng. III. and Eng. IV.)

The Junior and Senior Years continue the study of English as shown in the course of study. Twelve hours of English are required to satisfy the requirements for graduation, but beginning with the Junior year, the course will be largely determined by the efficiency and needs of the class. The course will constantly aim at stimulating careful observation and logical thinking, which 'form the basis of clear expression.

MODERN LANGUAGES.

This course at present offers German only. Twelve hours are required to qualify for graduation from each course offered in the Engineering Department.

The object of the German courses is to give the student a working knowledge of reading, writing and speaking,—with special emphasis upon comprehensive reading. The medium of class communication is changed from English to German as early as is practicable.

The first year is devoted to German grammar, which is taught by the direct method, and enough theme writing and classic reading to acquire a reasonable knowledge of German idioms, constructions and methods of thought. (Courses German I. and German II.)

The second year is devoted to reading and translation of German technical works on scientific and engineering subjects.

These subjects are chosen with a view to furnishing the student with a knowledge of the nomenclature of Chemistry, Physics and such mechanical sciences as lie within the general scope of the profession of engineering. (Courses German III. and German IV.)

Students offering German as one of their entrance requirements may take the second year's technical German for part of their language credits.

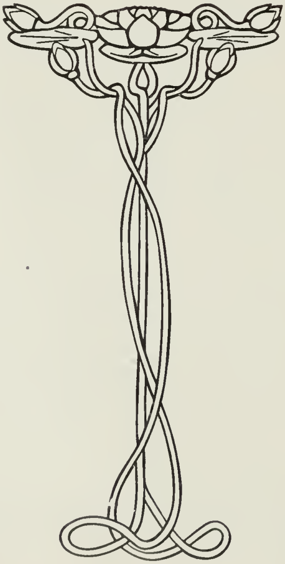
DIRECTORY.

The President, William F. Dooley, S. J.,
University of Detroit, Detroit, Michigan.

The Dean, College of Arts, William T. Doran, S. J.,
University of Detroit, Detroit, Michigan.

The Dean, College of Engineering, J. R. McColl,
University of Detroit, Detroit, Michigan.

The Dean, College of Law, Judge George S. Hosmer,
University of Detroit, Detroit, Michigan.



REGISTER OF ENGINEERING STUDENTS, 1912-1913.

Ameel, Albert	Freshman Class
Brennan, Frank	Freshman Class
Carter, Fred S.	Freshman Class
Chesterfield, Percy	Freshman Class
Chisholm, Charles H.	Freshman Class
Collins, Leo Grover	Freshman Class
Corcoran, James	Freshman Class
Counts, Jay W.	Freshman Class
Crowe, William	Sophomore Class
Crowley, Leo F.	Freshman Class
Eades, Clarence A	Freshman Class
Fitzgerald, Edmund	Freshman Class
Fitzsimons, William E.	Freshman Class
Glaser, Clarence	Sophomore Class
Kanka, Victor	Sophomore Class
Langlois, Cyril O.	Freshman Class
Leszczynski, George	Sophomore Class
Menninger, Edward	Freshman Class
Nebel, Alvin J.	Freshman Class
Nolan, Frederick A.	Freshman Class
Obrecht, Norbert	Special
Oddy, William C.	Freshman Class
Reinhardt, Theodore A.	Freshman Class
Reno, Eugene A.	Sophomore Class
Reynolds, T. Ernest	Sophomore Class
Rohret, Louis A.	Freshman Class
Sheahan, Frank	Freshman Class
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Smith, Emery	Freshman Class
Streeter, Will Grover	Sophomore Class
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Young, Francis J.	Freshman Class

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University of Detroit

BULLETIN

PUBLISHED MONTHLY FROM APRIL TO JULY BY
THE UNIVERSITY OF DETROIT, DETROIT, MICHIGAN.

VOL. I MAY No. 2

Co-Operative Engineering Courses

1914-1915

Application Made for Entry as Second-Class Matter at the Post Office at Detroit, Michigan.

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Calendar

1914.

July 1 to Sept. 15—Registration and Assignment to work in Shop Department. (See page 13.)

Sept. 15, Tuesday—Registration Day.

Sept. 16, Wednesday—Classes begin at 8 A. M.

Nov. 26-28, Thursday to Saturday—Thanksgiving Recess.

Dec. 21, Monday—Christmas Recess begins.

1915.

Jan. 4, Monday—Classes resumed.

Feb. 1-5, Monday to Friday, First semester examinations for Section I.

Feb. 8-12, Monday to Friday, First semester examinations for Section II.

Feb. 16, Tuesday—Second semester begins.

Mar. 31, Wednesday—Spring recess begins.

Apr. 7, Wednesday—Classes resumed.

June 21-25, Monday to Friday—Final examinations in non-technical subjects.

July 26-30, Monday to Friday—Final examinations in technical subjects.

July 30, Friday—Last day of college year.

July 1 to Sept. 14—Registration in Shop Department. (See page 13.)

Sept. 14, Tuesday—College year begins.

Faculty

WILLIAM F. DOOLEY, S. J.,
President of the University.

J. R. MCCOLL, B. S.,
Dean.

ALOYSIUS F. HEITKAMP, S. J.,
Professor of Chemistry and Mathematics.

LOUIS A. OFFER, B. M. E.,
Professor of Drawing and Mechanical Engineering.

JOHN B. KREMER, S. J.,
Professor of Physics.

JOHN B. FROEBES, S. J.,
Professor of Mathematics.

JOSEPH WILCZEWSKI, S. J.,
Professor of Mathematics and Applied Mechanics.

HENRY J. CLEMENS, B. S.,
Supervisor of Shop-work and Co-ordination.

JOSEPH SCHNITZLER, B. S.,
Professor of German and English.

Alanson Partridge Brush,
Lecturer on Gas and Steam Engines.

Alexander Dow,
Lecturer in Electrical Engineering.

George J. Lieber,
Lecturer on "Accident Prevention, Its Relationship to the Cost of Insurance."

Thomas F. McCrickett, C. E.,
Lecturer in Civil Engineering.

Frederick Marion Odena, Jr.,
Lecturer on Power Plant Construction.

Allan A. Templeton,
Lecturer in Shop Management.

William H. McGregor,
John H. Weller,
Charles H. Gifford,
Special Lecturers.

E. A. Werbe,
Registrar.

General Statement

This institution was incorporated April 27, 1881, according to the general law of the State of Michigan under the corporate title of "Detroit College," with power to grant such literary honors and confer such degrees as are usually conferred by similar colleges and institutions of learning in the United States. On January 10, 1911, the corporate title was changed to that of

"UNIVERSITY OF DETROIT."

The University buildings are located on Jefferson Avenue, less than one-half mile from the heart of the city and easily accessible to all street car lines.

ENGINEERING COURSE.

The course in engineering offered by the University of Detroit differs from the usual courses in engineering by following what is known as the co-operative plan, whereby the university works in direct contact with the manufacturing plants of the city,—namely, the student spends alternate weeks in the class-room and in the shops.

This departure is a result of the realization of the fact that industrial education, given in direct contact with the environments where it is afterwards to be applied, will train more efficient and skillful engineers than a course in which the practical application of the theories of the class-room is principally confined to the shops and laboratories of the university. The course, therefore, makes theory and practice go hand in hand. The student, during his course, covers all the subjects which are taught in approved engineering schools, while he is experiencing the practical side of his profession in the field where that profession is later to be exercised.

There is no longer question of the practicability of this plan. Experience has already proven it both here and in other industrial centers. Wherever students are employed in the shops under the co-operative plan, manufacturers have given their approval of the system and have been ready to accommodate in their plants a great number of such students.

The students find the combination of practical work and theory less of a strain, and derive more benefit from the plan than by continuous application to class-room work.

Located as the school is, in a great industrial center, it is easy to understand how experience in every possible variety of engineering work is open to the student. The list of co-operating plants which may be found on another page of this announcement, shows plainly how ample are the possibilities of learning in actual practice the principles of mechanical, electrical and civil engineering.

CO-OPERATIVE SYSTEM.

The co-operative system of combining the theory and practice is carried on as follows:

The student is placed at work in a machine shop, drafting room, or with a surveying or construction party,—depending on the course he has chosen,—for about half of the time allotted to the course, while the other half is spent in the university class-room.

The system is put into practical operation by dividing the class into two equal sections. One section is placed at work in the shops (the term "shops" in this bulletin means the place of the student's practical employment) and the other section takes up its work in the class-room. At the end of each week the sections are reversed. To every position in the shops, two students are assigned. In this way the employer's machine and equipment, allotted to the co-operative students, are in constant use.

These shop positions at the co-operating plants are secured by the university and belong to the university,—thus the students are relieved of all responsibility of securing positions for themselves. This arrangement relieves the student of all care and uncertainty in seeking employment, and enables the university to grade the student's work at the shops.

ADVANTAGES OF THE PLAN.

Experience is showing more clearly every day that in the training of an engineer the practical side of his profession should be strongly emphasized. The profession is nothing, if not practical. For this reason, it is not sufficient to confine the student's time and energy to the analysis of mathematical and scientific theories and the explanation of principles governing the different departments of engineering, but his training must be in the field of practical application of theory. The laboratory has failed in the past to impart the full training requisite for the engineer.

The need of this practical training is openly acknowledged by deans and professors of engineering schools throughout the country.

They usually advise their students to don the overalls immediately after graduation. Whatever the reason may be, this advice is not usually followed and we oftener find engineering graduates in the drafting room or business office rather than in the machine shop or on the girders of a bridge or building. In our system, work in mechanical, civil and electrical construction is part and parcel of the course.

A second advantage consists in the fact that the positions held by the students pay from 10 to 25 cents an hour, depending upon the efficiency of the student, thus enabling him to pay part of his expenses. Therefore a student can defray his expenses while at school to the extent of from $14.00 to $25.00 per month. When calculated at the end of the school-year, it will be found that a student has earned at the shops enough to cover the expenses of tuition, matriculation, laboratory fees and books.

A third advantage is that a student need not complete an entire engineering course only to discover, when he has worked for awhile in some field of engineering, that he has adopted a profession not in keeping with his tastes and ability. By the co-operative arrangement it is possible for the student to come very early to a conclusion, because he immediately finds himself under actual working conditions and is thrown into contact with practical engineers.

A fourth advantage consists in the fact that the student has the opportunity to display before employers whatever talent and ability he may possess, and thus it is made easier for him to find employment after graduation. Often students are offered positions early in their course, and can begin, even in the first or second year, to specialize in the theory requisite for those positions.

A fifth advantage is the fact that the student is working from eight to ten hours a day with a class of men who do the detail work in engineering operations. He learns habits of industry that will prove invaluable, and he gets a view of work from the shopman's standpoint.

CO-OPERATING PLANTS.

The following are the plants co-operating with the University of Detroit:

American Blower Company
American Car & Foundry Co.
American Pattern Works
Bryant & Detwiler Co.
Burroughs Adding Machine Co.
Detroit Shipbuilding Co.
Detroit Stove Works
Detroit Twist Drill Co.
Detroit United Railway
Edison Illuminating Co.
Federal Motor Truck Co.
Fulton-National Brass Co.
General Motors Company
Great Lakes Engineering Co.
Harrigan and Reid Co.
Johnson, Larson & Co.
Lauer Machine Co.
Michigan Central Railroad Co.
Michigan State Telephone Co.
Michigan Stove Works
Motor Truck Body Co.
National Twist Drill Co.
Northern Engineering Works
Packard Motor Car Co.
Parke, Davis and Co.
Partlan, James W., Co.
Peninsular Stove Works
Russel Wheel and Foundry Co.
Schultz, A. W.
Solvay Process Co.
United States Tire Co.

In securing the co-operation of the foregoing companies the university has been careful to select those plants where a general class of work is carried on. It has favored machine shops that require the skilled machinist, rather than the machine hand who repeats over and over again certain operations. An examination of the list will disclose the fact that plants have been favored which turn out large units, such as cranes, steam engines and heating systems, and also those which have machine shops for the manufacture and repair of their own equipment.

When assignments are made to plants engaged in turning out a great number of the same product, such as an adding machine or automobile, arrangements are made whereby the student is shifted from machine to machine and from department to department as fast as he learns the operations. Railroads in and about Detroit, construction companies, electrical plants and power houses, each in its own particular line of engineering, give ample opportunities to the earnest student to specialize in civil or electrical engineering.

CO-ORDINATOR.

The shop department is under the supervision of a co-ordinator, who is a graduate engineer and a journeyman mechanic. He divides his time between the shop and the university. He makes the rounds of the shops where the students are employed and familiarizes himself with the conditions, and keeps an accurate record of each student's progress. At the university he presides over what is known as the co-ordination class, where shop problems are discussed. Furthermore, his duty is to act in an advisory capacity to the professors of mechanics, mechanisms, machine design, strength of materials, etc., in order that problems which the students have encountered in their practical experience may receive more detailed exposition.

REQUIREMENTS FOR ADMISSION.

Candidates for admission must be at least seventeen years of age. They must either present a certificate of graduation from an accredited high school, or give evidence of having satisfactorily completed an amount of preparatory study represented by fifteen units, as explained below. A unit represents a year's study in any subject in a High School, assuming that the length of the school-year is from thirty-six to forty weeks, that a period is from forty to sixty minutes in length, and that the study is pursued for four or five periods a week.

The units presented must include the following:

English	3 units
Algebra (through Quadratics)	1 unit
Geometry, Plane	1 unit
Geometry, Solid	½ unit
Physics	1 unit
History	1 unit
Language	1½ units
	9 units

The remaining six units may be selected from the following list:

Manual Training	2 units	Chemistry	1 unit
Drawing	1 or 2 units	Trigonometry	½ unit
Civics	½ unit	German	2 units
History	1 unit	French	2 units
Astronomy	½ unit	Spanish	1 unit
Geology	½ unit	Latin	2 units
Physical Geography	½ or 1 unit	Greek	2 units
		English	1 unit

Candidates for admission who have no deficiencies should fill out entrance blanks (which may be obtained from Registrar) and have them signed by the principal of the school where credits were earned.

Those who have deficiencies must have their entrance blanks in the office of the university by August 15th.

Examinations for admission will be held from August 24th to August 29th.

Students who lack credits in subjects other than Algebra through Quadratics, Plane and Solid Geometry may enter the regular course on condition that they make up lacking credits during the first year.

If a diploma is not presented, evidence of honorable dismissal must be given from the preparatory school or college last attended.

MATRICULATION.

Matriculation in the engineering department may be made between July 1st and September 15th. Candidates who decide to enter this department should communicate with the dean of the department as early as possible. They should make an exact statement as to fitness to satisfy entrance requirements. The university wishes applicants to enroll as soon as possible, in order to give them some weeks of practical experience at the shops before the opening of classes. Candidates who enter early, not only have the benefit of more shop experience, but the additional advantage of securing better positions.

SPECIAL STUDENTS: Persons wishing to do university work in engineering will be admitted to classes as special students on payment of special fee. Should such students afterwards desire to apply for a degree, they must first satisfy all the entrance requirements.

ADVANCED STANDING: Candidates who have successfully carried on any of the subjects given in this course may apply for advanced standing to the professor in charge of that particular course. Application for advanced standing should be made within the first three class weeks of each semester.

DEGREES.

The degree of Bachelor of Civil Engineering, (B. C. E) Bachelor of Mechanical Engineering, (B. M. E.) and Bachelor of Electrical Engineering, (B. E. E.) will be given to students who have satisfactorily completed the five year course mapped out on the following pages.

TERMS IN THE ENGINEERING COURSE.

A matriculation fee of $5.00 is paid by all students of the university before entering upon any course and entitles them to permanent membership in the university.

Regular students in the engineering department pay an annual tuition fee of $100.00, payable in two equal installments, one before the beginning of each semester. No fees will be refunded.

Students entering before the beginning of the first semester, (Sept. 15th) must pay their matriculation fee and $25.00 (one-half of the first semester's tuition) before taking up their shop-work. The remaining $25.00 must be paid at the beginning of the semester, Sept. 15th.

Special students will be charged a fee of $3.00 per credit. A credit, as explained later, is the equivalent of one class period per week for one semester. The credit value of each course is given in the schedule of studies.

A laboratory fee of $5.00 will be charged for each semester's course in the physical, chemical, mechanical, civil and electrical laboratories.

A small deposit for breakage will also be required in these courses.

GENERAL REGULATIONS.

The enrollment card filled out at the time of enrollment must be revised when necessary. Notice of change of address, telephone number, course desired, etc., must be given at the office as soon as possible.

UNIT OF CREDIT: The unit of credit is one hour of class recitation, two hours of laboratory or three hours of drawing period per week for one semester. The credit value of each course is given under Schedule of Studies.

Absence from Class: Tardiness and absence must be accounted for to the head of the department in which it occurs. If he deem the excuse admissible, he will give an opportunity to make up time lost; if not, five points will be deducted from the student's credits.

Absence from Shop: Absence from shop should be reported at once to the co-ordinator and also to the foreman of the shop, if possible. Avoidable absence from shop will not be tolerated, as it reflects upon the good name of all the students in the shops.

Discipline in Shop: A student while in the shop is subject to the rules and regulations of the shop. His behavior there, not only reflects seriously upon the university, but determines his success in the course.

Notice of Discontinuance of Course: A student, upon enrolling into this department, does so on the condition that in case he decides to discontinue his course, he will notify the authorities of the university at least one week in advance. The week's notice is necessary so that the resultant changes in the shops can be made without disturbing the factory arrangements. Failure to serve this notice forfeits the student's right to an honorable dismissal. Withdrawal during the semester means loss of all credits for work done that semester. No fees are refunded.

Standings: Records of the examinations and class-work will be kept and recorded:

A	means	Excellent	90-100
B	"	Good	80- 89
C	"	Fair	67- 79
D	"	Conditioned	55- 66
E	"	Failed	0- 54

Conditions (D) must be removed before the beginning of the next semester. Failure (E) means student must repeat the course before he can go to advanced work in the same department.

Courses Offered.

As will be noted from the appended Schedule of Studies, three complete engineering courses are offered, Mechanical, Civil and Electrical.

For the first two years the studies are common to all courses, so that the student need not determine upon the particular branch until the end of his second year. The following brief synopsis of each course will help the student to make an intelligent choice:

MECHANICAL ENGINEERING.

Besides the fundamental sciences common to all branches of engineering, this course offers special opportunities in steam and gas engineering, and power-plants.

The work, special to this branch, includes the designing of steam and gas engines and steam turbines, and a study of methods of power distribution and application by both mechanical and electrical means. Complete power-plant designs are made both for the generation of electrical power and for direct use in manufacturing plants, and students become familiar with all forms of steam, gas, and electrical machinery through their study and operation in the course at the university and in the shops. This course also includes the designing of shops, traveling cranes and power distribution systems. The course is intended to train production engineers and managers of manufacturing plants of all kinds.

CIVIL ENGINEERING.

The first aim is to impart as broad a scientific training as the length of the course and the essential professional studies will allow, so that as many avenues to successful service as possible may be open to the graduate. Along professional lines, emphasis is laid first, on work in surveying and field methods, as these are of special value to civil engineers; second, on mechanics and its applications to the design of roofs, bridges and other structures;

third, on the theory and practice of re-enforced concrete construction; fourth, on railway location and construction; fifth, on sanitary and municipal engineering, including water supply, sewerage, roads and pavements.

A specialized course in bacteriology, particularly in its relation to water supply and sewerage, a broad and general study of sanitary science as related to public health problems, courses in the design of engineering structures related to sewage disposal and water purification. Stress is placed on the study of principles as being the things not likely to be acquired in after-life.

ELECTRICAL ENGINEERING.

The course in Electrical Engineering is designed to train the student in the building of power-plants; in the electrification of shops, tunnels, railroads, cities; in the transmission and distribution of power, in telephoning, and wireless telegraphy. The co-operative plan of engineering calls for a wide and varied experience in practical electrical work. The aim of the entire course is to develop in the student those qualities which are essential to the engineer, as well as those that are essential to the electrical artisan.

Schedule of Studies.

MECHANICAL ENGINEERING.

FIRST SEMESTER—FRESHMAN YEAR.

Subject.	Course.	Hours.	Credits.
Trigonometry	Math. 1	6	6
Chemistry	Ch. 1	4	4
Chemistry, Laboratory	Ch. 1a	6	3
Descriptive Geometry, Recitations	M. E. 1	3	3
Descriptive Geometry, Drawing	M. E. 1a	6	2
Co-ordination	C. 1	2	2
English	Eng. 1	2	2
German	Ger. 1	3	3
		32	25

SECOND SEMESTER—FRESHMAN YEAR.

Subject.	Course.	Hours.	Credits.
College Algebra	Math. 2	6	6
Chemistry	Ch. 2	4	4
Chemistry, Laboratory	Ch. 2a	4	2
Descriptive Geometry, Recitations	M. E. 2	3	3
Descriptive Geometry, Drawing	M. E. 2a	9	3
Co-ordination	C. 2	2	2
English	Eng. 2	2	2
German	Ger. 2	3	3
		33	25

FIRST SEMESTER—SOPHOMORE YEAR.

Subject.	Course.	Hours.	Credits.
Analytical Geometry	Math. 3	6	6
Physics (Mechanics and Sound)	Physics 1	4	4
Physics, Laboratory	Physics 1a	6	3
Co-ordination	C. 3	2	2
Qualitative Analysis	Ch. 3	1	1
Qualitative Analysis, Laboratory	Ch. 3a	6	3
English	Eng. 3	2	2
German	Ger. 3	3	3
		30	24

SECOND SEMESTER—SOPHOMORE YEAR.

Subject.	Course.	Hours.	Credits.
Differential Calculus	Math. 4	6	6
Physics (Heat and Light)	Physics 2	4	4
Physics, Laboratory	Physics 2a	6	3
Co-ordination	C. 3	2	2
Mechanisms	M. E. 3	5	5
Mechanisms (Drawing)	M. E. 3a	6	2
English	Eng. 4	2	2
German	Ger. 4	3	3
		34	27

FIRST SEMESTER—PRE-JUNIOR YEAR.

Subject.	Course.	Hours.	Credits.
Integral Calculus	Math. 5	6	6
Physics (Electricity and Magnetism)	Physics 3	4	4
Physics, Laboratory	Physics 3a	6	3
Machine Drawing	M. E. 4	9	3
Mechanisms and Graphical Statics	M. E. 3b	5	5
Economics	E. 1	2	2
Co-ordination	C. 4	2	2
		34	25

SECOND SEMESTER—PRE-JUNIOR YEAR.

Subject.	Course.	Hours.	Credits.
Mechanics	Math. 6	6	6
Surveying, Recitations	C. E. 4	1	1
Surveying, Field Work	C. E. 4a	6	3
Co-ordination	C. 5	2	2
Heat Engines	M. E. 5	5	5
Metallurgy	Ch. 6	2	2
Electrical Engineering	E. E. 1	4	4
Electrical Engineering, Laboratory	E. E. 1a	6	3
		32	26

FIRST SEMESTER—JUNIOR YEAR.

Subject.	Course.	Hours.	Credits.
Structural Mechanics	C. E. 1	5	5
Machine Design	M. E. 8	5	5
Electrical Engineering	E. E. 2	4	4
Electrical Engineering, Laboratory	E. E. 2a	4	2
Machine Design (Drawing)	M. E. 9	6	2
Valve Gears	M. E. 6	3	3
Co-ordination	C. 6	2	2
		29	23

SECOND SEMESTER—JUNIOR YEAR.

Subject.	Course.	Hours.	Credits.
Machine Design	M. E. 10	6	2
Thermodynamics	M. E. 11	5	5
Hydraulics	C. E. 3	4	4
Strength of Materials	C. E. 2	5	5
Heating and Ventilating	M. E. 20	3	3
English (Public Speaking)	Eng. 5	2	2
Co-ordination	C. 7	2	2
		27	23

FIRST SEMESTER—SENIOR YEAR.

Subject.	Course.	Hours.	Credits.
Steam Laboratory	M. E. 7	8	4
Steam Turbines	M. E. 18	3	3
Hoisting Machinery	M. E. 12	9	3
Gas Engines	M. E. 14	3	3
Hydraulic Machinery	C. E. 7	3	3
English	Eng. 6	2	2
Economics	E. 2	3	3
		31	21

SECOND SEMESTER—SENIOR YEAR.

Subject.	Course.	Hours.	Credits.
Steam Laboratory	M. E. 13	8	4
Marine Engineering	M. E. 19	3	3
Power Plants	M. E. 15	3	3
Gas Engine Design or	M. E. 16		
Automobile Design	M. E. 17	8	4
Thesis		6	6
		28	20

CIVIL ENGINEERING.

FIRST SEMESTER—PRE-JUNIOR YEAR.

(Freshman and Sophomore Years same as Mechanical Engineering.)

Subject.	Course.	Hours.	Credits.
Integral Calculus	Math. 5	6	6
Physics (Electricity and Magnetism)	Physics 3	4	4
Physics, Laboratory	Physics 3a	6	3
Machine Drawing	M. E. 4	9	3
Mechanisms and Graphical Statics	M. E. 3b	5	5
Economics	E. 1	2	2
Co-ordination	C. 4	2	2
		34	25

SECOND SEMESTER—PRE-JUNIOR YEAR.

Subject.	Course.	Hours.	Credits.
Mechanics	Math. 6	6	6
Surveying, Recitations	C. E. 4	1	1
Surveying, Field Work	C. E. 4a	6	3
Heat Engines	M. E. 5	5	5
Metallurgy	Ch. 6	2	2
Electrical Engineering	E. E. 1	4	4
Electrical Engineering, Laboratory	E. E. 1a	6	3
Co-ordination	C. 5	2	2
		32	26

FIRST SEMESTER—JUNIOR YEAR.

Subject.	Course.	Hours.	Credits.
Structural Mechanics	C. E. 1	5	5
Electrical Engineering	E. E. 2	4	4
Electrical Engineering, Laboratory	E. E. 2a	4	2
Topographical Drawing	C. E. 5	9	3
Co-ordination	C. 6	2	2
Surveying	C. E. 6	8	4
		32	20

SECOND SEMESTER—JUNIOR YEAR.

Subject.	Course.	Hours.	Credits.
Surveying	C. E. 8	8	4
Hydraulics	C. E. 3	4	4
Strength of Materials	C. E. 2	5	5
English (Public Speaking)	Eng. 5	2	2
Geology		3	3
Electives		2	2
Co-ordination	C. 8	2	2
		26	22

FIRST SEMESTER—SENIOR YEAR.

Subject.	Course.	Hours.	Credits.
Framed Structures	C. E. 9	5	5
Hydraulic Machinery	C. E. 7	3	3
English	Eng. 6	2	2
Economics	E. 2	3	3
Cement Theory	C. E. 10	3	3
Civil Engineering, Laboratory	C. E. 11	6	3
Structural Design	C. E. 12	9	3
		31	22

SECOND SEMESTER—SENIOR YEAR.

Subject.	Course.	Hours.	Credits.
Power Plants	M. E. 15	3	3
Municipal Engineering	C. E. 13	5	5
Engineering Design	C. E. 14	9	3
Sanitary Engineering	C. E. 15	2	2
Thesis		6	6
		25	19

ELECTRICAL ENGINEERING.

FIRST SEMESTER—PRE-JUNIOR YEAR.

(Freshman and Sophomore Years same as Mechanical Engineering).

Subject.	Course.	Hours.	Credits.
Integral Calculus	Math. 5	6	6
Physics (Electricity and Magnetism)	Physics 3	4	4
Physics, Laboratory	Physics 3a	6	3
Machine Drawing	M. E. 4	9	3
Mechanisms and Graphical Statics	M. E. 3b	5	5
Economics	E. 2	2	2
Co-ordination	C 4	2	2
		34	25

SECOND SEMESTER—PRE-JUNIOR YEAR.

Subject.	Course.	Hours.	Credits.
Mechanics	Math. 6	6	6
Surveying, Recitations	C. E. 4	1	1
Surveying, Field Work	C. E. 4a	6	3
Heat Engines	M. E. 5	5	5
Metallurgy	Ch. 6	2	2
Electrical Engineering	E. E. 1	4	4
Electrical Engineering, Laboratory	E. E. 1a	6	3
Co-ordination	C. 5	2	2
		32	26

FIRST SEMESTER—JUNIOR YEAR.

Subject.	Course.	Hours.	Credits.
Structural Mechanics	C. E. 1	5	5
Electrical Engineering	E. E. 2	4	4
Electrical Engineering, Laboratory	E. E. 2a	4	2
Electrical Design	E. E. 4	9	3
Telephones	E. E. 9	2	2
Machine Design	M. E. 8	5	5
Co-ordination	C. 6	2	2
		31	23

SECOND SEMESTER—JUNIOR YEAR.

Subject.	Course.	Hours.	Credits.
Electrical Machinery	E. E. 3	5	5
Electric Power Transmission	E. E. 5	3	3
Hydraulics	C. E. 3	4	4
Strength of Materials	C. E. 2	5	5
English (Public Speaking)	Eng. 5	2	2
Co-ordination	C 9	2	2
		21	21

FIRST SEMESTER—SENIOR YEAR.

Subject.	Course.	Hours.	Credits.
Steam Turbines	M. E. 18	3	3
Economics		3	3
English	Eng. 6	2	2
Illumination	E. E. 10	3	3
Electrical Laboratory	E. E. 11	8	4
Electrical Design	E. E. 6	9	3
Electives		3	3
		31	21

SECOND SEMESTER—SENIOR YEAR.

Subject.	Course.	Hours.	Credits.
Power Plants	M. E. 15	3	3
Electrical Design	E. E. 8	6	2
Electrical Railroads	E. E. 7	2	2
Electives		6	6
Thesis		6	6
		23	19

Description of Studies.

MECHANICAL ENGINEERING.

M. E. I. Descriptive Geometry:—The first half of this course consists of practice in lettering, use of instruments, construction of geometrical figures and practice in drawing irregular curves. It is designed to give the student the necessary experience in drawing, to enable him to execute neat and accurate descriptive geometry plates. The last half covers that part of Descriptive Geometry which deals with the representation and solution of problems regarding right lines and planes. Lectures, recitations and drawing periods.

M. E. 2. Descriptive Geometry (Continuation of M. E. 1):—This course takes up plane and space curves; surfaces, such as single curved, double curved and warped; planes tangent to surfaces; lines of intersection and developments. Lectures, recitations and drawing periods.

M. E. 3. Mechanisms:—Investigation of the laws of kinematics with a study of practical machines which illustrate them. Practical problems in differential screws, worms and wheels, pulleys, belts, cams, link work, wheels in trains, and curves for gear teeth are solved both analytically and graphically. Lectures, recitations and drawing periods.

M. E. 4. Machine Drawing:—Drafting room standards, including dimensioning, cross sectioning and representing screw threads, bolts, nuts, etc. are first taken up. Complete mechanical drawings are then made from sketches, and finally, drawings of machine parts from models. The method employed is that of making free-hand sketches from which the detail drawing is made. From the detail drawings, assembly drawings are made, thus checking their completeness. Some time is spent in tracing and blue printing. Great care is exercised in this course to give the student a knowledge of the best practice used in the most modern drafting rooms.

M. E. 5. Heat Engines:—The principal power-producing machines are here studied, but principally the steam boiler and engine, and the gas producer and gas engine. Considerable time is given to the steam turbine.

M. E. 6. Valve Gears:—A study of the various kinds of valves used on steam and gas engines is taken up. A study is made of the Zeuner and Bilgrim diagrams with problems applied to steam valves. Considerable time is given to the study of the Stephenson, the Walschaert and the Joy Valve Gears. Governors are also considered.

M. E. 7. Mechanical Laboratory:—The aim in this course is to give the student actual practice in the use of steam engine testing apparatus. With this in view they are taught to calibrate steam engine indicators, thermometers, gauges, etc. The determination of the calorific value of coal, gas and oil is also taken up. The students' services as helpers will be offered to engineers in the city who are making tests on plants of all descriptions.

M. E. 8. Machine Design, Theoretic:—This is a course in which the theory taken up in C. E. 1 and 2 is used in designing machine parts. These parts include bolts, journals, shafts, pulleys, gears, connecting and piston rods, and frame works of machines. Recitations and lectures only.

M. E. 9. Machine Design, Drawing:—The design of boiler and steam engine parts is worked out carefully in the drawing room. This course gives the student ample opportunity to apply the principles learned in M. E. 8. As in all other drawing courses, reliable and practical working drawings are insisted upon.

M. E. 10. Machine Design, Tools:—Design of jigs, fixtures, and other machine tools.

M. E. 11. Thermodynamics:—In this course a study is made of the properties of gases and vapors under different conditions, as applied to the steam and gas engine, air compressor and refrigerating machine.

M. E. 12. Hoisting Machinery:—The object of this course is to give the student an opportunity to apply the theory of M. E. 8 to a structural machine,—the design of columns, girders, ropes and sheaves is included.

M. E. 13. Steam Laboratory:—Some of the time allotted to this course will be spent in the university laboratory, but the course consists principally in testing engines, turbines, boilers, etc., in plants about the city.

M. E. 14. Gas Engines:—This is a course of lectures and recitations covering the various types of gas engines. It includes a study of gas engine operation, testing and installation.

M. E. 15. Power Plants:—The arrangements, size and cost of the various units that are necessary in laying out a power house are here studied. Specifications for steam plants are also taken up.

M. E. 17. Automobile Design:—The principal parts that go into the automobile are carefully laid out, and working drawings made.

M. E. 18. Steam Turbines:—This course consists of lectures, recitations and problems covering the theory and construction of steam turbines. It includes a study of the principal points of both impulse and reaction turbines, such as nozzles, blades, etc., along with the commercial types. Efficiency and adaptability of turbines, as compared with other power producers, is an important feature.

M. E. 19. Marine Engineering:—A brief study is made of the engineering equipment of ships, such as types of engines, boilers, condensers, screws, paddle wheels, etc. The lake steamers will be considered principally.

M. E. 20. Heating and Ventilating:—In this course a study is made of the methods employed in heating and ventilating residences, shops and offices. The various kinds of heating systems, as hot water, direct and indirect steam, and hot air, are studied. Typical plants in the city are inspected and discussed. Lectures will be given by prominent engineers.

CIVIL ENGINEERING.

C. E. 1. Structural Mechanics:—In this course the theoretical principles of mechanics are applied to engineering structures. These include the determination of the stresses in the members that go to make up the roof trusses, bridges, arches, etc., the location of the centers of inertia, and the findings of the radii of gyration of cross-sections. Plotting of bending moment and shear diagrams is also covered.

C. E. 2. Strength of Materials:—The various properties of materials are studied to determine their ability to resist the stresses investigated in C. E. 1. The resisting moment of the materials in various shapes, such as common steel sections and timber and reinforced concrete beams. Pieces in compression, such as columns, posts and struts are investigated by means of Schneider's and Worster's formulae. Internal stresses in structural pieces are analyzed.

C. E. 3. Hydraulics:—In this course a study is made of the performance of water in its many applications to engineering work. This considers its flow through pipes, channels and orifices, and over weirs. Losses by friction in pipes is an important item. Practical problems in hydro-electrical plants are also discussed.

C. E. 4. Surveying:—One hour a week is given to lecture or quiz in the use of surveying instruments and methods of making surveys. It includes the reading of instruments, measuring distances and angles, staking out, measuring and computing traverses, running levels, making profiles and platting.

C. E. 4a. Surveying Field Work:—The class is divided into squads and detailed to different parts of the city to make the surveys, run sets of levels, etc.,—thus becoming perfectly familiar with the instruments and methods employed in surveying. The work in the field is carefully computed and tabulated in a field note-book.

C. E. 5. Topographical Drawing:—This course consists of a study of the practice in the conventional methods of representing topography, together with the platting of the results of field practice in connection with surveying. A complete map of a section in the city is required of each student.

C. E. 6. Surveying:—This course is required only of Civil Engineering students, and is part review and part extension of C. E. 4. Besides the subjects mentioned in that course, railroad curves, earthwork surveys and city platting is taken up.

C. E. 7. Hydraulic Machinery:—Water turbine theory and practice are studied along with other water power station machinery.

C. E. 8. Railroad Surveying:—In this course complete surveys are made for sections of both street and steam railroads. Curves, etc., of track already laid are surveyed and checked with theory given in text-books. The setting out of simple and compound curves and calculation of excavations and embankments. Yards, turnouts, and switches. Easement curves of various types. Calculation of water-ways, and methods of staking out foundations for culverts and bridges. Some time may be spent with the surveying parties of the railroads in the city.

C. E. 9. Framed Structures:—In this course an investigation is made of the stresses in trusses, arches, draw spans, etc. It applies the theory of C. E. 1 to specific problems. Various styles of trusses are studied and their members analyzed.

C. E. 10. Cement Theory:—The use of cement in the building of reinforced concrete structures, and solid cement work is studied. The extensive use of this material in buildings of all description makes this course of great importance. Practical examples are worked out. Part of the course will be given over to lectures by prominent engineers.

C. E. 11. Civil Engineering, Laboratory:—Torsion, compression, bending and shearing tests of timber, metals and concrete are carried on, and checked with the theory given in C. E. 1 and 2.

C. E. 12. Structural Design:—A complete framed structure is designed, and working drawings made. Here, as in all other designing courses, practical working drawings are insisted upon.

C. E. 13. Municipal Engineering:—Construction of sewers, streets, pavements, etc., and their locations in cities, are taken up. This course will consist principally of lectures given by experts engaged in this work.

C. E. 14. Engineering Design:—In this course further practical application of the theoretical problems is made. It includes some complete structure, such as power building, mill, or small office building. As in all other drawing courses, the plates must be practical working drawings.

C. E. 15. Sanitary Engineering:—A broad and general view of the large body of sanitary science upon which the modern practice of sanitation is based. The effects of good practice in such matters as public water supply, sewerage and drainage, state and federal control over the pollution of streams, the elimination of dust and mud and snow from city streets, and the ventilation of public buildings. The course will consist mostly of lectures by prominent engineers.

ELECTRICAL ENGINEERING.

E. E. 1. Direct Current Machinery:—In this course a partial review of that part of physics which deals with electricity is first taken up. This is followed by a careful study of the direct current motor, generator, the storage battery, etc. On account of the important part that electricity now plays in nearly every engineering project, this course is required of all students, and is made very thorough. The course consists of lectures, problems and recitations.

E. E. 1a. Direct Current, Laboratory:—Actual tests are made to determine the efficiency, performance, etc., of various types of direct current machines.

E. E. 2. Alternating Current Machinery:—The object of this course is to give the student a fair understanding of the alternating current and its many important applications. The motor, generator, converter, mercury arc rectifier and transformer are studied in detail.

E. E. 2a. Alternating Current Machinery, Laboratory:—Tests are made upon the various machines, both in the university laboratory, and in the power plants of the city.

E. E. 3. Electrical Machinery:—This course reviews courses E. E. 1 and 2, and takes up in greater detail the machines studied therein. Special study is made of the theory of the alternating current and its application. Operation of electrical machinery is an important item.

E. E. 4. Direct Current Electrical Design:—In this course the complete design is made of a direct current motor and an electromagnet. Practical working drawings are insisted upon.

E. E. 5. Electric Power Transmission:—The central electrical station, and long distance transmission lines are studied.

E. E. 6. Alternating Current Electrical Design:—This course is similar to E. E. 4, but considers only alternating machines, such as transformers, converters, etc.

E. E. 7. Electrical Railroads:—The aim here is to give the student a fair idea of the solution of the principal problems met in electrical railroads. These include the determination of power required by trains, methods of electrical transmission, arrangement of schedules, etc.

E. E. 8. Electrical Design:—The electrical part of the installation of a modern power house is designed. Details of the switchboards, conduits, generators and motor settings are made.

E. E. 9. Telephones:—A study is made of the theory of the electrical transmission of speech. Long distance and local systems are investigated. Time is given to the inspection of central stations, and wherever possible, lectures by telephone experts are given.

E. E. 10. Illumination:—A study is made of the theory of illumination, and the practical methods employed in furnishing light for streets and buildings.

E. E. 11. Electrical Laboratory:—Advanced experiments with electrical machinery, and the testing of machines. As far as possible these tests will be made in the electrical plants of the city.

MATHEMATICS.

1. Trigonometry:—Definitions and relations of trigonometric functions; logarithms; solutions of trigonometric equations. Determination of sides, angles and areas of right and oblique triangles in both plane and spherical trigonometry. Practice in the use of logarithmic and trigonometric tables, and solution of original problems.

2. Advanced Algebra:—Review of surds, imaginaries and quadratic equations and their geometrical representation. Special study is made of binomial theorem, permutations and combinations, convergence and divergence, theory of equations, partial fractions.

3. Analytical Geometry:—The object of this course is to familiarize the student with analytical methods of investigation; representation of the straight line, circle, parabola, ellipse and hyperbola by means of equations. A short time is devoted to solid analytic geometry.

4. Differential Calculus:—A very thorough course in differential calculus is given, including variables, functions and limits, differentiation, maxima and minima, radii and centers of curvature and tracing of curves.

5. Integral Calculus:—Methods of integration as applied to finding of areas, volumes, length of curves, and moments of inertia.

6. Mechanics:—This course brings together all the principles of physics and mathematics that have a direct bearing on the purely engineering subjects which follow it in the course. It takes up the laws of motion, such as momentum, force and energy. Parallel and concurrent forces, statics, principles of work, rectilinear and curvilinear motion, and finally centers of inertia and radii of gyration are very carefully considered.

CHEMISTRY.

1. **Elementary Inorganic Chemistry**:—A study of the occurrence, preparation, physical and chemical properties of metals and non-metals. Their use and application in the arts. Symbols and equations. Laws of definite and multiple proportion. Equivalent, molecular and atomic weights. Oxidation, reduction, decomposition, dissociation, ionization and hydrolysis.

2. **Inorganic Chemistry**:—A thorough study of metals and non-metals, their classification, their use in engineering problems. Kinetic molecular hypothesis. Theory of solution and dissociation. Colloids, hydrosols and hydrogels. Chemical equilibrium, ionization and the interaction of ionic substances. Ionic theory of precipitation and solution, complex ions.

1a and 2a. **Chemical Laboratory**:—A selection of experiments will enable the student to familiarize himself with the elements and compounds, but especially fit him to attack the problems that may present themselves to the practical engineer.

3. **Qualitative Analysis**:—Analytical actions, separations and identifications in the light of modern theories of ionic solution and equilibrium.

3. **Qualitative Laboratory**:—In the laboratory, selected reactions and separations which exercise the observational and reflective powers of the student, whilst giving the technical knowledge necessary to discover the constituents of simple alloys, ores and minerals.

4. **Quantitative Analysis**:—Determination of exact amount of each of the different constituents in any compound. Gravimetric and volumetric. Elective.

5. **Organic Chemistry**:—Introduction to the carbon compounds and their principal derivatives. Elective.

6. **Metallurgy**:—Fuels and other means of obtaining high temperatures: Furnaces and their accessories. Treatment of the principal iron ores. Metallography.

GENERAL PHYSICS.

Instruction in Physics is given by lectures illustrated by numerous demonstrations and by recitations from lessons assigned in a text-book. The object of the course is to acquaint the student with experimental facts, as well as with the quantities used in Physics and the theory and method of calculation. Particular attention is given to the fundamental principles and the solution of problems of a practical nature. A special effort is made to adapt the course to the needs of technical students. For this reason most of the time will be given to such subjects as are correlated to later technical work.

The course includes the treatment of the mechanics of solids, liquids and gases; heat, sound, light, magnetism and electricity.

Laboratory Physics: The laboratory experiments are intended to give the students,—not only a practical knowledge in the use of standard apparatus, and training in the methods of making and recording physical measurements,—but also a firmer grasp and clearer insight into the physical laws and phenomena. More stress is laid on the grasp of principles and personal resourcefulness on the part of the student than on mere skill in following a set of directions. The student is required to keep an accurate and detailed record of every experiment performed. The work required is not only accurate, but as far as possible, individual,—and great importance is laid on the discussion of the sources of error.

Experiments in the branches of the different subjects are selected from laboratory manuals of Ames & Bliss, Stewart & Gee, Miller, Millikan and others. Accurate measurements of length, mass and density, by means of comparator, cathetometer and balance; the determination of the constants of gravity, inertia and elasticity; calorimetric measurements; the use of the spectroscope, spectrometer, polariscope, and grating; determination of the velocity and pitch of sound; magnetic and electrical measurements are among the more important exercises.

ECONOMICS.

Introductory: Definitions.—Political Economy, Economic Laws. Economic goods, positive and negative. Personal goods. Wealth. Consumable and productive goods. Value, individual and social. Exchange. Price, cost, labor. Income. Capital. Expenditure.

Production. Productive capacities of the Earth. Two factors of Production. Points of Physical Geography. Important conclusions. Limitations of Earth's Resources. Intensity of Production. Law of Diminishing Returns. Suitable Degree of Intensity.

Productive powers of man. Variations depending on race, nationality, morality. General and technical education.

Industrial Organization. Nature, varieties, extent, advantages, drawbacks; physical, moral, economic. Misconceptions on division of Labor and Machinery.

Industrial Progress. Meaning and kinds. Historical Survey. The Industrial Revolution. Its effects. False explanation of unsatisfactory conditions today. The true explanations.

Industrial Locality and Dimension. Conditions and Advantages of Localization. Growth of Cities. Industry and Business. Varieties of large and small scale Industries. Advantages and Drawbacks of large and small. History of co-operation.

Consumption. Meaning of Consumption. Limits of human wants. Theory of marginal value. Absolute and conventional necessaries. Standard of Life. Superfluities and Luxuries. Food: What it embraces. Famines and their prevention. The Housing Problem in modern cities. Fuel and Light. Clothing and Adornment. Furniture. Medical Expenditure. General Education. Religious Expenditure. Cost of Justice and of Recreations.

Population and Subsistence. Malthusianism. Declining Birthrate. Increasing means of Substance. Extravagance. Unused Resources. Colonization. Malthusianism and Providence.

Exchange. Reasons for Trade. Market Prices. Monopoly Prices. Different kinds of Monopoly. Why Monopolies exist. The Proper Remedy for the Evils of Monopoly. Differential gains and the factors producing them. Their Capitalization. International Trade. Its Nature, Advantages and Drawbacks. Free Trade versus Protection.

Money: Need and Nature of Money. Kinds of money at different periods. Token Money. Credit. Different kinds and uses of banks. The Clearing System. Commercial Use of Securities. International Exchange. Use and Abuse of Commercial Credit. Uncommercial Credit and its Dangers.

Distribution. Profits: Rate, Amount, Real, Nominal, Hiddenness of. Mobility of Labor and Capital as tending to equalize Profits. Interest, meaning and kinds. Rate and amount. Reasons for varying rate. Mobility of Labor and Capital as affecting rates of. Wages: rate and amount, real and nominal, maximum and minimum. Wages and Cost of Living. Pessimist and Optimist Wage-theories. Riches and Poverty from the economical and ethical standpoint. Wisdom and folly of the War on Riches; Communism, Anarchism, Socialism, Collectivism, Socialization of Land.

ENGLISH.

FRESHMAN.

The first year's English consists of a brief review of the principles of rhetoric with special attention to the theme and paragraphic unit. Theme writing is begun at once with special emphasis upon a clear and concise expression of thought. The student is soon required to write reviews of leading articles in current scientific periodicals, the aim constantly being to obtain a natural and exact expression of thought.

One hour per week is spent in text book study, which also comprises a study of English and American masterpieces, and one hour per week is given to theme work, as noted above, throughout the freshman year. (Courses Eng. I. and Eng. II.)

Unless the student already possesses a literary education, he is also required to do a certain amount of outside reading. This reading comprises works of poetry, fiction, essays, history, biography and science.

READING REQUIRED OF FRESHMAN STUDENTS

The following course of reading is required of all freshmen in this department. The object of the requirement is to supplement the regular class work by giving the student examples of well-rendered thought, as presented by the best writers in the several departments of literature.

Such literature, when earnestly read, will also necessarily broaden the student's knowledge and stimulate his powers of thought and expression.

Each student should read, during the academic year, as many books from the following lists as will give him a total credit of 75 points. Students having credit in college literary work will be credited for such work, and will not be required to do the full 75 points of reading.

I. SCIENCE.

FISHER, MRS. A. B.: A Short History of Natural Science, (25).
NEWCOMB, SIMON: Astronomy for Everybody, (25).
CLERK, AGNES: History and Astronomy in the 19th Century, (25).
WASMANN: Modern Biology and Evolution (25).
WALSH, J.: Thirteenth Greatest of Centuries, (20).
NORTON: Elements of Geology, (20).
CHAMBERLIN AND SALISBURY: College Geology, (20).
FOURNIER: Electron Theory, (20).
SNYDER, CARL: New Conceptions in Science, (20).
FRANKLAND, P. F.: Our Secret Friends and Foes, (20).
PROCTOR, R. A.: Other Worlds Than Ours, (20); Light Science for Leisure Hours, (10).
BYRN, E. W.: Progress of Inventions in the Nineteenth Century, (20).
SHALER, N. S.: Nature and Man in America, (20); Man and the Earth, (15).
LUBBOCK, J.: Scientific Lectures, (20).
DUNCAN, R. K.: The New Knowledge (Radium, Etc.), (15).
THOMPSON, S. P.: Light, Visible and Invisible, (15).
RUSSELL, I. C.: Lakes of North America, (15).
ILES, G.: Flame, Electricity and the Camera, (15).

MENDENHALL, T. C.: A Century of Electricity, (15).
GERARD: Old Riddle and Newest Answer, (15).
MCCULLOUGH, E.: Engineering as a Vocation, (10).
TALBOT, F. A.: Railway Conquest of the World, (10); Steamship Conquest of the World, (10).

II. HISTORY AND BIOGRAPHY.

FISKE, JOHN: American Revolution, 2 vols., (40); Discovery of America, 2 vols., (40); Beginnings of New England, (25); Old Virginia and Her Neighbors, 2 vols., (40).
GRANT, U. S.: Personal Memoirs, 2 vols., (40).
LEE, SIDNEY: Great Englishmen of the Sixteenth Century, (25).
CREASY, E. S.: Fifteen Decisive Battles of the World, (20).
RAWSON, E. K.: Twenty Famous Naval Battles, (20).
MACAULAY, T. B.: History of England, Vol. I., Chap. 3, (10).
HARCOURT, L. F.: Vernon; Achievements in Engineering, (20).
MOFFETT, CLEVELAND: Careers of Danger and Daring, (20).
COCHRANE, C. H.: Wonders of Modern Mechanism, (20).
COCHRANE, ROBERT: Romance of Industry and Invention, (20).
CHURCH, W. C.: Life of John Ericcson, (20).
SMILES, S.: Lives of George and Robert Stephenson, (20), and of Bolton and Watt, (20), in "Lives of the Engineers."
THOMPSON, S. P.: Michael Faraday, His Life and Work, (20).
BRYCE, J.: American Commonwealth, (20); Hindrances to Good Citizenship, (20).
COOLIDGE, A. C.: The United States as a World Power, (20).
CATTELL, J. M.: American Men of Science, (20).
GARNETT, W.: Heroes of Science: Physicists, (20).
JORDAN, D. S.: Leading American Men of Science, (20).
MUIR, J.: Heroes in Science: Chemists, (20).
PARTON, J.: Captains of Industry, (20).
JONES, F. A.: Life of Thomas Edison, (20).
VALLERY-RADOT: Life of L. Pasteur, (20).
MORSE, J. T., JR.: Life of Abraham Lincoln, (20).
THORPE, T. E.: Humphrey Davey, Poet and Philosopher, (20).
BREWSTER, SIR DAVID: Life of Sir Isaac Newton, (20).
CLERKE, MISS A. M.: The Herschels and Modern Astronomy, (20).
GLAZEBROOK, R. T.: James Clerk Maxwell, (20).
FRANKLIN, BENJAMIN: Autobiography, (10).

III. FICTION.

BULWER-LYTTON, E. L.: The Last Days of Pompeii, (25).
DICKENS, CHARLES: A Tale of Two Cities, (20); David Copperfield, (20).

Scott, Walter: Woodstock, (20); Guy Mannering, (20); Kenilworth, (20); Quentin Durward, (20); Waverly, (20).
Stevenson, R. L.: Kidnapped, (20).
Hawthorne, Nathaniel: The House of Seven Gables, (20).
Cooper, J. F.: The Pilot, (20); The Spy, (20).
Allen, James Lane: The Reign of Law, (20).
Kipling, Rudyard: Captains Courageous, (15).

IV. Essays and Poetry.

Lamb, Charles: Essays of Elia, (25).
Dante: Inferno, Norton's Translation, (25).
Homer: Iliad, (25); Odyssey, (25).
Tennyson, Alfred: In Memoriam, (20); Maud, (20).
Browning, R.: Pippa-Passes, (10); A Soul's Tragedy, (20); Strafford, (20).
Shakespeare: Hamlet. (15); Othello, (15); The Merchant of Venice, (15); Macbeth, (10); The Tempest, (10); King Lear, (10); Twelfth Night, (10).

V. Miscellaneous.

Holaind: Ownership and Natural Right, (20).
Ryan: A Living Wage, (20).
Scott, W. R.: The Americans in Panama, (20).
Clark, F. E.: The Continent of Opportunity, (15).
Roosevelt, T.: The Winning of the West, (15).
Devas: Key to the World's Progress, (15).
Bates, A.: Talks on Writing English, (15).
Greenough, J. B. and Kittredge, G. L.: Words and Their Ways in English Speech, (15).
Lounsbury, T.: Standard of Usage in English, (15).
Carrington, T. S.: Fresh Air and How to Use It, (10).
Oliver, T.: Diseases of Occupation, (10).
Wiley, H. W.: Foods and Their Adulteration, (10).

SOPHOMORE.

The second year continues the theme work, but a large share of the subject matter is furnished by the student's shop experiences and by inspections of the many engineering problems and constructions, which only a large city can furnish. The student is encouraged to observe and to express in scientific language what he has seen. Here also the study of English and American masterpieces is continued. (Courses Eng. III. and Eng. IV.)

The Junior and Senior Years continue the study of English as shown in the course of study. Twelve hours of English are required to satisfy the requirements for graduation, but beginning with the Junior year, the course will be largely determined by the efficiency and needs of the class. The course will constantly aim at stimulating careful observation and logical thinking, which form the basis of clear expression.

MODERN LANGUAGES.

This course at present offers German only. Twelve hours are required to qualify for graduation from each course offered in the Engineering Department.

The object of the German courses is to give the student a working knowledge of reading, writing and speaking,—with special emphasis upon comprehensive reading. The medium of class communication is changed from English to German as early as is practicable.

The first year is devoted to German grammar, which is taught by the direct method, and enough theme writing and classic reading to acquire a reasonable knowledge of German idioms, constructions and methods of thought. (Courses German I. and German II.)

The second year is devoted to reading and translation of German technical works on scientific and engineering subjects.

These subjects are chosen with a view to furnishing the student with a knowledge of the nomenclature of Chemistry, Physics and such mechanical sciences as lie within the general scope of the profession of engineering. (Courses German III. and German IV.)

Students offering German as one of their entrance requirements may take the second year's technical German for part of their language credits.

CO-ORDINATION.

C.1 to C.9: These courses consist of two class periods per week at the university. The students from the various shops are brought together into one class, and their difficulties and experiences are discussed. From time to time shop superintendents and foremen are invited to send in problems and questions arising in their daily work. These, as far as possible, are worked out by the faculty engineers and students, and the class-room is made a sort of clearing house for knowledge. Whenever any subject is under consideration, such as shop management, power transmission, routing of work, limits of accuracy, feeds and cuts of machine tools, overhead costs, time keeping systems, etc., the students discuss the methods followed in the different plants. In this way a very broad idea of the work carried on in the several shops is brought to each student.

Shop mathematics, methods of setting up and doing different operations on the machines and at the bench are studied. Tables for curves are worked out for simplifying such work as cutting tapers, threads, feeds and speeds, etc. The student will, from time to time, be expected to write reports on what he has observed in the shop, and read them before the class.

INSPECTION TRIPS.

Detroit offers great opportunity for visiting engineering plants of all descriptions. Among the works inspected are electric lighting, shipbuilding, automobile, railroad car, stove, steam engine, blower, and bridge companies. The material for many of the themes for the English courses will be taken from these trips.

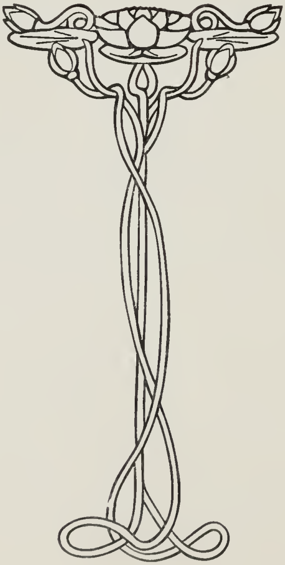
DIRECTORY.

The President, William F. Dooley, S. J.,
University of Detroit, Detroit, Michigan.

The Dean, Department of Arts, William T. Doran, S. J.,
University of Detroit, Detroit, Michigan.

The Dean, Department of Engineering, J. R. McColl,
University of Detroit, Detroit, Michigan.

The Dean, Department of Law, Judge George S. Hosmer,
University of Detroit, Detroit, Michigan.



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University of Detroit

BULLETIN

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SEP 4 1919

PUBLISHED MONTHLY FROM APRIL TO JULY BY
THE UNIVERSITY OF DETROIT, DETROIT, MICHIGAN

VOL. II MAY No. 2

Co-Operative Engineering Courses

1915-1916

Entered as Second-Class Matter at the Post Office at Detroit, Michigan

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1916

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Calendar

1915.

June 1 to Sept. 14—Registration and Assignment to work in Shop Department. (See page 16.)

Sept. 14, Tuesday—Registration Day.

Sept. 15, Wednesday—Classes begin at 8 A. M.

Nov. 25-27, Thursday to Saturday—Thanksgiving Recess.

Dec. 20, Monday—Christmas Recess begins.

1916.

Jan. 3, Monday—Classes resumed.

Feb. 21-26, Monday to Saturday—First semester examinations for Section A.

Mar. 6-11, Monday to Saturday—First semester examinations for Section B.

Apr. 20, Thursday—Spring recess begins.

May 4, Thursday—Classes resumed.

June 26-30, Monday to Friday—Final examinations in non-technical subjects.

June 24-28, Monday to Friday—Final examinations in technical subjects.

July 31, Monday—Last day of college year.

June 1 to Sept. 11—Registration in Shop Department. (See page 16.)

Sept. 12, Tuesday—College year begins.

Faculty

WILLIAM F. DOOLEY, S. J.,
President of the University.

JAY R. MCCOLL, B. S.,
Dean.

LOUIS A. OFFER, B. M. E.,
Assistant Dean and Professor of Mechanical Engineering.

ALOYSIUS F. HEITKAMP, S. J.,
Professor of Chemistry and Mathematics.

JOSEPH WILCZEWSKI, S. J.,
Professor of Electricity.

JOHN B. FROEBES, S. J.,
Professor of Mathematics and German.

WILLIAM J. THOME, C. E.,
Professor of Civil Engineering.

EDWARD J. POSSELIUS, B. S.,
Assistant Professor of Electricity.

JAMES P. MONAGHAN, S. J.,
Professor of Physics.

JOSEPH SCHNITZLER, B. S., LL. B.,
Professor of English.

William P. Winch, LL. B.,
Professor of Contracts.

*____ ______ ________

Professor of Drawing.

Alden F. Barker,
Supervisor of Shop-Work and Co-ordination.

Alexander Dow,
Lecturer in Electrical Engineering.

George J. Lieber,
Lecturer on "Accident Prevention."

Thomas F. McCrickett, C. E.,
Lecturer in Civil Engineering.

Frederick Marion Odena, Jr.,
Lecturer on Power Plant Construction.

E. A. Werbe,
Registrar.

*(To be appointed.)

General Statement

This institution was incorporated April 27, 1881, according to the general law of the State of Michigan under the corporate title of "Detroit College," with power to grant such honors and confer such degrees as are usually conferred by similar colleges and institutions of learning in the United States. On January 10, 1911, the corporate title was changed to that of

"UNIVERSITY OF DETROIT."

The University buildings are located on Jefferson Avenue, less than one-half mile from the heart of the city and easily accessible to all street car lines.

ENGINEERING COURSE.

The course in engineering offered by the University of Detroit differs from the usual courses in engineering by following what is known as the co-operative plan, whereby the university works in direct contact with the manufacturing plants of the city,—namely, the student spends alternate two weeks in the class-rooms and in the shops.

This departure is a result of the realization of the fact that industrial education, given in direct contact with the environments where it is afterwards to be applied, will train more efficient and skillful engineers than a course in which the practical application of the theories of the class-room is principally confined to the shops and laboratories of the university. The course, therefore, makes theory and practice go hand in hand. The student, during his course, covers all the subjects which are taught in approved engineering schools, while he is experiencing the practical side of his profession in the field where that profession is later to be exercised.

There is no longer question of the practicability of this plan. Experience has already proven it both here and in other industrial centers. Wherever students are employed in the shops under the co-operative plan, manufacturers have given their approval of the system and have been ready to accommodate in their plants a great number of such students.

The students find the combination of practical work and theory less of a strain, and derive more benefit from the plan than by continuous application to class-room work.

Located as the school is, in a great industrial center, it is easy to understand how experience in every possible variety of engineering work is open to the student. The list of co-operating plants, which may be found on another page of this announcement, shows plainly how ample are the possibilities of learning in actual practice the principles of mechanical, civil and electrical engineering.

New Engineering Building.

The New Engineering Building, which is situated on the south side of Jefferson Avenue, directly opposite the main buildings of the University, will be formally opened at the beginning of the school year, 1915-16.

It will be a fire-proof structure of four stories and basement, built of reinforced concrete. The front will be of Bedford limestone, carrying out the design now embodied in the main building of the University.

As may be seen from the floor plans shown on pages 10 and 11, the general outline of the building represents a huge block letter I. It has a frontage of 100 feet on Jefferson Avenue and extends back to Woodbridge Street 200 feet.

The front section of the first floor will be devoted entirely to lobby and offices. The lobby separates the Dean's and President's offices. On either side of the back part of the lobby stairs lead to the floors above, while directly in the rear is located a passenger elevator.

The two rear sections of the first floor are devoted to the mechanical, civil and electrical laboratories.

The second floor is given over to recitation rooms, drawing rooms and lecture halls. On the third and fourth floors will be located the Physics and Chemistry Departments. These floors will also furnish ample accommodation in spacious lecture and recitation rooms.

MECHANICAL LABORATORY.

The Mechanical Laboratory is especially designed to give a very broad and up-to-date course in the testing and operating of all types and models of steam, gas and water power machinery. The floor is of concrete construction, and is provided with inserts which insure a rapid setting up of engines and other apparatus, in almost any position desired. A number of large holes are also provided through which the steam, gas and water pipes, electrical wires, etc., may be brought up from the sub-basement and connected closely to the machine to be tested.

Special provisions have been made for the easy handling of the apparatus to be tested. A five ton crane spans the laboratory and runs its entire length. This crane insures a very ready means of handling the apparatus in the laboratory, and with the help of the wagon hatch provided at the rear, the problem of bringing in and out any piece of machinery is made easy and practicable.

Representative types of turbines, steam engines, gas and oil engines, air and water pumps and fans will be installed.

The boiler room, which is located in the southeast corner, is designed with ample ceiling height and area to accommodate almost any type of boiler. Space is provided here for gas producers, pumps, weighing tanks, etc., and is therefore part of the general steam laboratory. A mezzanine is located above the boiler space.

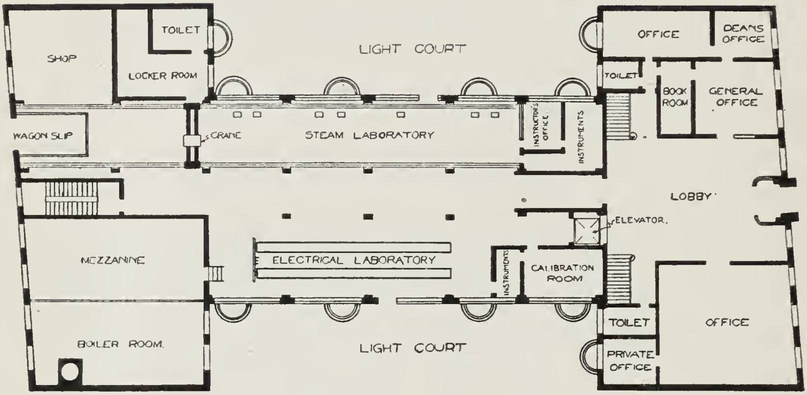
ELECTRICAL LABORATORY.

For the testing of electrical apparatus a space 100 x 25 feet has been allotted. Two hollow concrete benches have been provided, upon which the motors, generators and other apparatus will be mounted. At each machine a terminal board is installed and is electrically connected by means of wires inside of the benches to a main distributing board located at the end of the motor benches. At the board connections may be made to the main power lines, resistances or instruments.

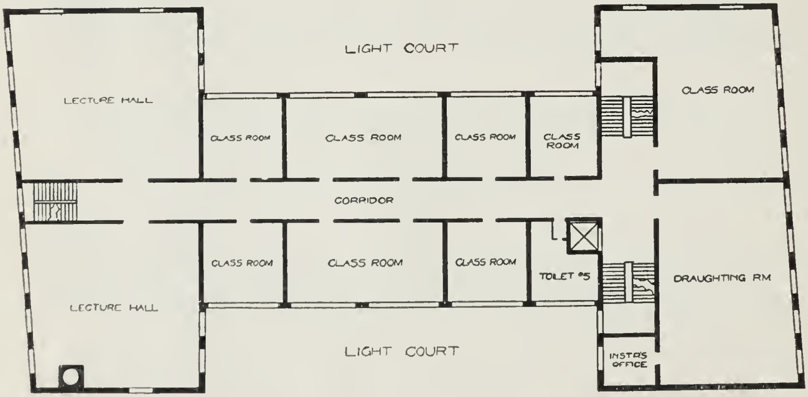
At the front end of the laboratory is the calibration room, and between this and the main laboratory is the instrument room.

CIVIL LABORATORY.

The light courts will be reserved for the building of beams, setting up of segments of floors, etc., and general testing of materials. The cement laboratories and testing machines will be located in the rear of basement.

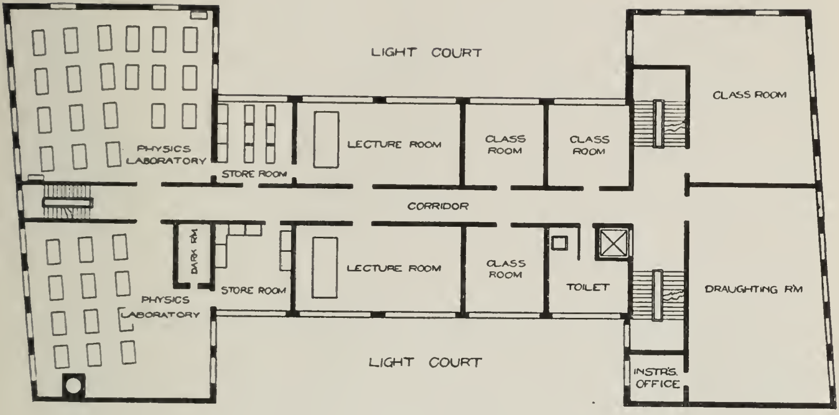


FIRST FLOOR PLAN

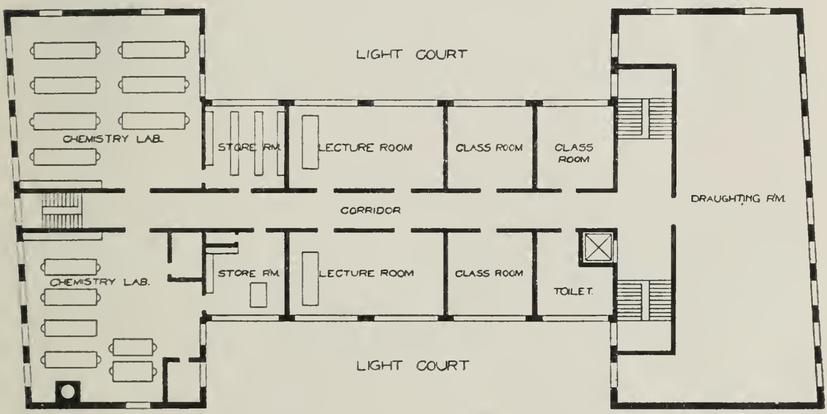


SECOND FLOOR PLAN.

Floor Plans of the New Engineering Building.



THIRD FLOOR PLAN.



FOURTH FLOOR PLAN.

Floor Plans of the New Engineering Building.

CO-OPERATIVE SYSTEM.

The co-operative system of combining the theory and practice is carried on as follows:

The student is placed at work in a machine shop, drafting room, or with a surveying or construction party,—depending on the course he has chosen,—for about half of the time allotted to the course, while the other half is spent in the university class-rooms.

The system is put into practical operation by dividing the class into two equal sections. One section is placed at work in the shops (the term "shops" in this bulletin means the place of the student's practical employment) and the other section takes up its work in the class-room. At the end of each two weeks the sections are reversed. To every position in the shops, two students are assigned. In this way the employer's machine and equipment, allotted to the co-operative students, are in constant use.

These shop positions at the co-operating plants are secured by the university and belong to the university,—thus the students are relieved of all responsibility of securing positions for themselves. This arrangement relieves the student of all care and uncertainty in seeking employment, and enables the university to grade the student's work at the shops.

ADVANTAGES OF THE PLAN.

Experience is showing more clearly every day that in the training of an engineer the practical side of his profession should be strongly emphasized. The profession is nothing, if not practical. For this reason, it is not sufficient to confine the student's time and energy to the analysis of mathematical and scientific theories and the explanation of principles governing the different departments of engineering, but his training must be in the field of practical application of theory. The laboratory has failed in the past to impart the full training requisite for the engineer.

The need of this practical training is openly acknowledged by deans and professors of engineering schools throughout the country.

They usually advise their students to don the overalls immediately after graduation. Whatever the reason may be, this advice is not always followed, and we more often find engineering graduates in the drafting room or business office rather than in the machine shop or on the girders of a bridge or building. In our system, work in mechanical, civil and electrical construction is part and parcel of the course.

A second advantage consists in the fact that the positions held by the students pay from 10 to 25 cents an hour, depending upon the efficiency of the student, thus enabling him to pay part of his expenses. Therefore a student can defray his expenses while at school to the extent of from $14.00 to $25.00 per month. When calculated at the end of the school-year, it will be found that a student has earned at the shops enough to cover the expenses of tuition, matriculation, laboratory fees and books.

A third advantage is that a student need not complete an entire engineering course only to discover, when he has worked for a while in some field of engineering, that he has adopted a profession not in keeping with his tastes and ability. By the co-operative arrangement it is possible for the student to come very early to a conclusion, because he immediately finds himself under actual working conditions and is thrown into contact with practical engineers.

A fourth advantage consists in the fact that the student has the opportunity to display before employers whatever talent and ability he may possess, and thus it is made easier for him to find employment after graduation. Often students are offered positions early in their course, and can begin, even in the first or second year, to specialize in the theory requisite for those positions.

A fifth advantage is the fact that the student is working from eight to ten hours a day with a class of men who do the detail work in engineering operations. He learns habits of industry that will prove invaluable, and he gets a view of work from the shopman's standpoint.

CO-OPERATIVE PLANTS.

The following are the plants co-operating with the University of Detroit:

American Blower Company
American Car & Foundry Co.
American Pattern Works
Bryant & Detwiler Co.
Burroughs Adding Machine Co.
Detroit Shipbuilding Co.
Detroit Stove Works
Detroit Twist Drill Co.
Detroit United Railway
Edison Illuminating Co.
Federal Motor Truck Co.
Gemmer Manufacturing Co.
General Motors Company
Great Lakes Engineering Co.
Harrigan and Reid Co.
Johnson, Larson & Co.
Lauer Machine Co.
Michigan Central Railroad Co.
Michigan State Telephone Co.
Michigan Stove Works
Motor Truck Body Co.
National Twist Drill Co.
Northern Engineering Works
Packard Motor Car Co.
Parke, Davis and Co.
James W. Partlan Co.
Peninsular Stove Works
Russel Wheel and Foundry Co.
A. W. Schultz
Solvay Process Co.
United States Tire Co.
W. E. Wood Co.

In securing the co-operation of the foregoing companies the university has been careful to select those plants where a general class of work is carried on. It has favored machine shops that require the skilled machinist, rather than the machine hand who repeats over and over again certain operations. An examination of the list will disclose the fact that plants have been favored which turn out large units, such as cranes, steam engines and heating systems, and also those which have machine shops for the manufacture and repair of their own equipment.

When assignments are made to plants engaged in turning out a great number of the same product, such as an adding machine or automobile, arrangements are made whereby the student is shifted from machine to machine and from department to department as fast as he learns the operations. Railroads in and about Detroit, construction companies, electrical plants and power houses, each in its own particular line of engineering, give ample opportunities to the earnest student to specialize in civil or electrical engineering.

CO-ORDINATOR.

The shop department is under the supervision of a co-ordinator who is a graduate engineer and a journeyman mechanic. He divides his time between the shop and the university. He makes the rounds of the shops where the students are employed and familiarizes himself with the conditions, and keeps an accurate record of each student's progress. At the university he presides over what is known as the co-ordination class, where shop problems are discussed. Furthermore, his duty is to act in an advisory capacity to the professors of mechanics, mechanisms, machine design, strength of materials, etc., in order that problems which the students have encountered in their practical experience may receive more detailed exposition.

REQUIREMENTS FOR ADMISSION.

Candidates for admission must be at least seventeen years of age. They must either present a certificate of graduation from an accredited high school, or give evidence of having satisfactorily completed an amount of preparatory study represented by fifteen units, as explained below. A unit represents a year's study in any subject in a High School, assuming that the length of the school-year is from thirty-six to forty weeks, that a period is from forty to sixty minutes in length, and that the study is pursued for four or five periods a week.

The units presented must include the following:

English	3 units
Algebra (through Quadratics)	1 unit
Geometry, Plane	1 unit
Geometry, Solid	½ unit
Physics	1 unit
History	1 unit
Language	1½ units
	9 units

The remaining six units may be selected from the following list:

Manual Training	2 units
Drawing	1 or 2 units
Civics	½ unit
History	1 unit
Astronomy	½ unit
Geology	½ unit
Physical Geography	½ or 1 unit
Chemistry	1 unit
Trigonometry	½ unit
German	2 units
French	2 units
Spanish	1 unit
Latin	2 units
Greek	2 units
English	1 unit

Candidates for admission who have no deficiencies should fill out entrance blanks (which may be obtained from Registrar) and have them signed by the principal of the school where credits were earned.

Those who have deficiencies must have their entrance blanks in the office of the university by August 16th.

Examinations for admission will be held from August 25th to August 31st.

Students who lack credits in subjects other than Algebra through Quadratics, Plane and Solid Geometry may enter the regular course on condition that they make up lacking credits during the first year.

If a diploma is not presented, evidence of honorable dismissal must be given from the preparatory school or college last attended.

MATRICULATION.

Matriculation in the engineering department may be made between June 1st and September 14th. Candidates who decide to enter this department should communicate with the dean of the department as early as possible. They should make an exact statement as to fitness to satisfy entrance requirements. The university wishes applicants to enroll as soon as possible, in order to give them some weeks of practical experience at the shops before the opening of classes. Candidates who enter early, not only have the benefit of more shop experience, but the additional advantage of securing better positions.

Special Students: Persons wishing to do university work in engineering will be admitted to classes as special students on payment of special fee. Should such students afterwards desire to apply for a degree, they must first satisfy all the entrance requirements.

Advanced Standing: Candidates who have successfully carried on any of the subjects given in this course may apply for advanced standing to the professor in charge of that particular course. Application for advanced standing should be made within the first three class weeks of each semester.

DEGREES.

The degree of Bachelor of Civil Engineering, (B. C. E.) Bachelor of Mechanical Engineering, (B. M. E.) and Bachelor of Electrical Engineering, (B. E. E.) will be given to students who have satisfactorily completed the five year course mapped out on the following pages.

TERMS IN THE ENGINEERING COURSE.

A matriculation fee of $5.00 is paid by all students of the university before entering upon any course and entitles them to permanent membership in the university.

Regular students in the engineering department pay an annual tuition fee of $100.00, payable in two equal installments, one before the beginning of each semester. No fees will be refunded.

Students entering before the beginning of the first semester, (Sept. 14th) must pay their matriculation fee and $25.00 (one-half of the first semester's tuition) before taking up their shop-work. The remaining $25.00 must be paid at the beginning of the semester, Sept. 14th.

Special students will be charged a fee of $3.00 per credit. A credit, as explained later, is the equivalent of one class period per week for one semester. The credit value of each course is given in the Schedule of Studies.

A laboratory fee of $5.00 will be charged for each semester's course in the physical, chemical, mechanical, civil and electrical laboratories, and a surveying fee of $3.00 for each semester's course. A small deposit for breakage will also be required in these courses.

For Freshman students the expenses are somewhat higher than for those in the other classes, due to the fact that the drawing equipment is purchased the first year.

Below is given a list of the expenses directly connected with the course:

FIRST SEMESTER.

Matriculation fee	$ 5.00	
Tuition fee	50.00	
Laboratory fee	5.00	
Drawing instruments	15.00	
Drawing material	4.50	
Books	7.00	
Locker fees	.50	
		$87.00

SECOND SEMESTER.

Tuition fee	$50.00	
Laboratory fee	5.00	
Books	4.50	
Locker fees	.50	
		$60.00

The succeeding years will average for *each semester* as follows:

Tuition fee	$50.00	
Laboratory or Surveying fee	5.00	
Books	5.50	
Locker fees	.50	
		$61.00

All the foregoing charges levied by the university on a student can be easily defrayed with the money earned in the shops. Each student will also have a portion of his shop wages left to assist him in paying his board and lodging.

BOARD AND ROOM.

There is a dormitory in connection with the university, which will accommodate a limited number of students. The cost of room rent is from $2.00 upwards, according to the location of the room. The cost of board is $4.00 per week and upwards.

GENERAL REGULATIONS.

The enrollment card filled out at the time of enrollment must be revised when necessary. Notice of change of address, telephone number, course desired, etc., must be given at the office as soon as possible.

Unit of Credit: The unit of credit is one hour of class recitation, two hours of laboratory or three hours of drawing period per week for one semester. The credit value of each course is given under Schedule of Studies.

Absence from Class: Tardiness and absence must be accounted for to the head of the department in which it occurs. If he deem the excuse admissible, he will give an opportunity to make up time lost; if not, five points will be deducted from the student's credits.

Absence from Shop: Absence from shop should be reported at once to the co-ordinator and also, if possible, to the foreman of the shop. Avoidable absence from shop will not be tolerated, as it reflects upon the good name of all the students in the shops.

Discipline in Shop: A student while in the shop is subject to the rules and regulations of the shop. His behavior there, not only reflects seriously upon the university, but determines his success in the course.

Notice of Discontinuance of Course: A student, upon enrolling in this department, does so on the condition that in case he decides to discontinue his course, he will notify the authorities of the university at least one week in advance. A week's notice is necessary so that the resultant changes in the shops can be made without disturbing the factory arrangements. Failure to serve this notice forfeits the student's right to an honorable dismissal. Withdrawal during the semester means loss of all credits for work done that semester. No fees are refunded.

Standings: Records of the examinations and class-work will be kept and recorded:

Excellent	90-100
Good	80- 89
Fair	67- 79
Conditioned	55- 66
Failed	0- 54

Conditions must be removed before the beginning of the next semester. Failure means student must repeat the course before he can go to advanced work in the same department.

Courses Offered.

As will be noted from the appended Schedule of Studies, three complete engineering courses are offered, Mechanical, Civil and Electrical. Each course covers a period of five years. The school year continues for eleven months.

For the first two years the studies are common to all courses, so that the student need not determine upon the particular branch until the end of his second year. The following brief synopsis of each course will help the student to make an intelligent choice:

MECHANICAL ENGINEERING.

Besides the fundamental sciences common to all branches of engineering, this course offers special opportunities in steam and gas engineering, and power plants.

The work, special to this branch, includes the designing of steam and gas engines and steam turbines, and a study of methods of power distribution and application by both mechanical and electrical means. Complete power-plant designs are made both for the generation of electrical power and for direct use in manufacturing plants, and students become familiar with all forms of steam, gas, and electrical machinery through their study and operation in the course at the university and in the shops. This course also includes the designing of shops, traveling cranes and power distribution systems. The course is intended to train production engineers and managers of manufacturing plants of all kinds.

CIVIL ENGINEERING.

The first aim is to impart as broad a scientific training as the length of the course and the essential professional studies will allow, so that as many avenues to successful service as possible may be open to the graduate. Along professional lines, emphasis is laid first, on work in surveying and field methods, as these are of special value to civil engineers; second, on mechanics and its applications to the design of roofs, bridges and other structures;

third, on the theory and practice of re-inforced concrete construction; fourth, on railway location and construction; fifth, on sanitary and municipal engineering, including water supply, sewerage, roads and pavements.

A specialized course in bacteriology, particularly in its relation to water supply and sewerage, a broad and general study of sanitary science as related to public health problems, courses in the design of engineering structures related to sewage disposal and water purification. Stress is placed on the study of principles as being the things not likely to be acquired in later life.

ELECTRICAL ENGINEERING.

The course in Electrical Engineering is designed to train the student in the building of power-plants; in the electrification of shops, tunnels, railroads, cities; in the transmission and distribution of power, in telephoning, and wireless telegraphy. The co-operative plan of engineering calls for a wide and varied experience in practical electrical work. The aim of the entire course is to develop in the student those qualities which are essential to the engineer, as well as those that are essential to the electrical artisan.

Schedule of Studies.

MECHANICAL ENGINEERING.

FRESHMAN YEAR—FIRST SEMESTER.

Subject.	Course.	Hours.	Credits.
Trigonometry	Math. 1	6	6
Chemistry	Ch. 1	4	4
Chemistry, Laboratory	Ch. 1a	6	3
Descriptive Geometry, Recitations	M. E. 1	3	3
Descriptive Geometry, Drawing	M. E. 1a	6	2
Co-ordination	C. 1	2	2
English	Eng. 1	2	2
German	Ger. 1	3	3
		32	25

FRESHMAN YEAR—SECOND SEMESTER.

Subject.	Course.	Hours.	Credits.
College Algebra	Math. 2	6	6
Chemistry	Ch. 2	4	4
Chemistry, Laboratory	Ch. 2a	4	2
Descriptive Geometry, Recitations	M. E. 2	3	3
Descriptive Geometry, Drawing	M. E. 2a	9	3
Co-ordination	C. 2	2	2
English	Eng. 2	2	2
German	Ger. 2	3	3
		33	25

SOPHOMORE YEAR—FIRST SEMESTER.

Subject.	Course.	Hours.	Credits.
Analytical Geometry	Math. 3	6	6
Physics (Mechanics and Sound)	Physics 1	4	4
Physics, Laboratory	Physics 1a	6	3
Co-ordination	C. 3	2	2
Qualitative Analysis	Ch. 3	1	1
Qualitative Analysis, Laboratory	Ch. 3a	6	3
English	Eng. 3	5	5
German	Ger. 3	3	3
		33	27

SOPHOMORE YEAR—SECOND SEMESTER.

Subject.	Course.	Hours.	Credits.
Differential Calculus	Math. 4	6	6
Physics (Heat and Light)	Physics 2	4	4
Physics, Laboratory	Physics 2a	6	3
Co-ordination	C. 3	2	2
Mechanisms	M. E. 3	5	5
Mechanisms (Drawing)	M. E. 3a	6	2
English	Eng. 4	3	3
German	Ger. 4	3	3
		35	28

PRE-JUNIOR YEAR—FIRST SEMESTER.

Subject.	Course.	Hours.	Credits.
Integral Calculus	Math. 5	6	6
Physics (Electricity and Magnetism)	Physics 3	4	4
Physics, Laboratory	Physics 3a	6	3
Machine Drawing	M. E. 4	9	3
Mechanisms and Graphical Statics	M. E. 3b	5	5
Economics	E. 1	2	2
Co-ordination	C. 4	2	2

PRE-JUNIOR YEAR—SECOND SEMESTER.

Subject.	Course.	Hours.	Credits.
Mechanics of Engineering, Statics	C. E. 1	6	6
Surveying, Recitations	C. E. 4	3	3
Surveying, Field Work	C. E. 4a	6	3
Co-ordination	C. 5	2	2
Heat Engines	M. E. 5	5	5
Metallurgy	Ch. 6	2	2
Electrical Engineering	E. E. 1	4	4
Electrical Engineering, Laboratory	E. E. 1a	6	3
		34	28

JUNIOR YEAR—FIRST SEMESTER.

Subject.	Course.	Hours.	Credits.
Mechanics of Eng. Dynamics	C. E. 2	6	6
Thermodynamics	M. E. 11	5	5
Electrical Engineering	E. E. 2	4	4
Electrical Engineering (Laboratory)	E. E. 2a	6	3
Machine Design (Drawing)	M. E. 9	9	3
Co-ordination	C. 6	2	2
Contracts	Law 1	2	2
		34	25

JUNIOR YEAR—SECOND SEMESTER.

Subject.	Course.	Hours.	Credits.
Machine Design	M. E. 8	5	5
Surveying	C. E. 5	3	3
Surveying (Field Work)	C. E. 5a	6	3
Strength of Materials	C. E. 3	5	5
Machine Design	M. E. 10	8	3
Co-ordination	C. 7	2	2
Electrical Machinery	E. E. 3	4	4
Contracts	Law 2	2	2
		35	27

SENIOR YEAR—FIRST SEMESTER.

Subject.	Course.	Hours.	Credits.
Steam Laboratory	M. E. 7	8	4
Steam Turbines	M. E. 18	3	3
Hoisting Machinery	M. E. 12	9	3
Gas Engines	M. E. 14	3	3
Hydraulics	C. E. 8	5	5
English (Public Speaking)	Eng. 5	2	2
Specifications	C. E. 21	3	3
Economics	E. 2	3	3
		35	26

SENIOR YEAR—SECOND SEMESTER.

Subject.	Course.	Hours.	Credits.
Steam Laboratory	M. E. 13	8	4
Marine Engineering	M. E. 19	3	3
Power Plants	M. E. 15	3	3
Gas Engine Design	M. E. 16		
or			
Automobile Design	M. E. 17	8	4
Electives	..	6	6
Heating and Ventilation	M. E. 20	3	3
		31	23

CIVIL ENGINEERING.

(Freshman and Sophomore Years same as Mechanical Engineering.)

PRE-JUNIOR YEAR—FIRST SEMESTER.

Subject.	Course.		Hours.	Credits.
Integral Calculus	Math.	5	6	6
Physics (Electricity and Magnetism)	Physics	3	4	4
Physics, Laboratory	Physics	3a	6	3
Machine Drawing	M. E.	4	9	3
Mechanisms and Graphical Statics	M. E.	3b	5	5
Economics	E.	1	2	2
Co-ordination	C.	4	2	2
			34	25

PRE-JUNIOR YEAR—SECOND SEMESTER.

Subject.	Course.		Hours.	Credits.
Mechanics of Engineering, Statics	Math.	6	6	6
Surveying, Recitations	C. E.	4	3	3
Surveying, Field Work	C. E.	4a	6	3
Heat Engines	M. E.	5	5	5
Metallurgy	Ch.	6	2	2
Electrical Engineering	E. E.	1	4	4
Electrical Engineering, Laboratory	E. E.	1a	6	3
Co-ordination	C.	5	2	2
Astronomy	Math.	6	2	2
			36	30

JUNIOR YEAR—FIRST SEMESTER.

Subject.	Course.		Hours.	Credits.
Mechanics of Engineering, Dynamics	C. E.	2	6	6
Electrical Engineering	E. E.	2	4	4
Electrical Engineering, Laboratory	E. E.	2a	6	3
Topographical Drawing	C. E.	7	9	3
Co-ordination	C.	6	2	2
Thermodynamics	M. E.	11	5	5
Contracts	Law	1	2	2
			34	25

JUNIOR YEAR—SECOND SEMESTER.

Subject.	Course.	Hours.	Credits.
Surveying	C. E. 5	3	3
Surveying, Field Work	C. E. 5a	6	3
Strength of Materials	C. E. 3	5	5
Electrical Machinery	E. E. 3	4	4
Civil Laboratory	C. E. 22	4	2
Co-ordination	C. 8	2	2
Roof Trusses	C. E. 10	7	3
Roads and Pavements	C. E. 20	3	3
Contracts	Law 2	2	2
		36	27

SENIOR YEAR—FIRST SEMESTER.

Subject.	Course.	Hours.	Credits.
Framed Structures	C. E. 11	5	5
Hydraulics	C. E. 8	5	5
English, Public Speaking	Eng. 5	2	2
Economics	E. 2	3	3
Masonry	C. E. 15	6	4
Civil Engineering, Laboratory	C. E. 22a	6	3
Plate Girder Design	C. E. 13	5	2
Specifications, Design	C. E. 21	3	3
		35	27

SENIOR YEAR—SECOND SEMESTER.

Subject.	Course.	Hours.	Credits.
Higher Structures	C. E. 12	4	4
Municipal Engineering	C. E. 18&19	5	5
Engineering Design	C. E. 14&17	15	6
Sanitary Engineering	C. E. 15	2	2
Railroad Survey	C. E. 6	3	3
Railroad Survey, Field Work	C. E. 6a	6	3
		35	23

ELECTRICAL ENGINEERING.

(Freshman and Sophomore Years same as Mechanical Engineering).

PRE-JUNIOR YEAR—FIRST SEMESTER.

Subject.	Course.		Hours.	Credits.
Integral Calculus	Math.	5	6	6
Physics (Electricity and Magnetism)	Physics	3	4	4
Physics, Laboratory	Physics	3a	6	3
Machine Drawing	M. E.	4	9	3
Mechanisms and Graphical Statics	M. E.	3b	5	5
Economics	E.	2	2	2
Co-ordination	C.	4	2	2
			34	25

PRE-JUNIOR YEAR—SECOND SEMESTER.

Subject.	Course.		Hours.	Credits.
Mechanics	Math.	6	6	6
Surveying, Recitations	C. E.	4	3	3
Surveying, Field Work	C. E.	4a	6	3
Heat Engines	M. E.	5	5	5
Metallurgy	Ch.	6	2	2
Electrical Engineering	E. E.	1	4	4
Electrical Engineering, Laboratory	E. E.	1a	6	3
Co-ordination	C.	5	2	2
			34	28

JUNIOR YEAR—FIRST SEMESTER.

Subject.	Course.		Hours.	Credits.
Mechanics of Eng. Dynamics	C. E.	2	6	6
Electrical Engineering	E. E.	2	4	4
Electrical Engineering, Laboratory	E. E.	2a	6	3
Electrical Design	E. E.	4	9	3
Thermodynamics	M. E.	11	5	5
Co-ordination	C.	6	2	2
Contracts	Law	1	2	2
			34	25

JUNIOR YEAR—SECOND SEMESTER.

Subject.	Course.	Hours.	Credits.
Electrical Machinery	E. E. 3	4	4
Electrical Power Transmission	E. E. 5	3	3
Machine Design	M. E. 8	5	5
Strength of Materials	C. E. 3	5	5
Surveying	C. E. 5	3	3
Surveying Field Work	C. E. 5a	6	3
Co-ordination	C. 9	2	2
Contracts	Law 2	2	2
		30	27

SENIOR YEAR—FIRST SEMESTER.

Subject.	Course.	Hours.	Credits.
Steam Turbines	M. E. 18	3	3
Economics	..	3	3
English (Public Speaking)	Eng. 6	2	2
Steam Laboratory	M. E. 7	8	4
Electrical Design	E. E. 6	9	3
Electives	..	3	3
Specifications	C. E. 21	3	3
Hydraulics	C. E. 8	5	5
		36	26

SENIOR YEAR—SECOND SEMESTER.

Subject.	Course.	Hours.	Credits.
Power Plants	M. E. 15	3	3
Electrical, Laboratory	E. E. 11	8	4
Electrical Railroads	E. E. 7	4	4
Electives	..	6	6
Thesis	..	6	6
Illumination	E. E. 10	3	3
		30	26

Description of Studies.

MECHANICAL ENGINEERING.

M. E. I. Descriptive Geometry:—The first half of this course consists of practice in lettering, use of instruments, construction of geometrical figures and practice in drawing irregular curves. It is designed to give the student the necessary experience in drawing, to enable him to execute neat and accurate descriptive geometry plates. The last half covers that part of Descriptive Geometry which deals with the representation and solution of problems regarding right lines and planes. Lectures, recitations and drawing periods.

M. E. 2. Descriptive Geometry (Continuation of M. E. 1):—This course takes up plane and space curves; surfaces, such as single curved, double curved and warped; planes tangent to surfaces; lines of intersection and developments. Lectures, recitations and drawing periods.

M. E. 3. Mechanisms:—Investigation of the laws of kinematics with a study of practical machines which illustrate them. Practical problems in differential screws, worms and wheels, pulleys, belts, cams, link work, wheels in trains, and curves for gear teeth are solved both analytically and graphically. Lectures, recitations and drawing periods.

M. E. 4. Machine Drawing:—Drafting room standards, including dimensioning, cross sectioning and representing screw threads, bolts, nuts, etc., are first taken up. Complete mechanical drawings are then made from sketches, and finally, drawings of machine parts from models. The method employed is that of making free-hand sketches from which the detail drawing is made. From the detail drawings, assembly drawings are made, thus checking their completeness. Some time is spent in tracing and blue printing. Great care is exercised in this course to give the student a knowledge of the best practice used in the most modern drafting rooms.

M. E. 5. Heat Engines:—The principal power-producing machines are here studied, but principally the steam boiler and engine, and the gas producer and gas engine. Considerable time is given to the steam turbine.

M. E. 6. Valve Gears:—A study of the various kinds of valves used on steam and gas engines is taken up. A study is made of the Zeuner and Bilgrim diagrams with problems applied to steam valves. Considerable time is given to the study of the Stephenson, the Walschaert and the Joy Valve Gears. Governors are also considered.

M. E. 7. Mechanical Laboratory:—The aim in this course is to give the student actual practice in the use of steam engine testing apparatus. With this in view they are taught to calibrate steam engine indicators, thermometers, gauges, etc. The determination of the calorific value of coal, gas and oil is also taken up. The students' services as helpers will be offered to engineers in the city who are making tests on plants of all descriptions.

M. E. 8. Machine Design, Theoretic:—This is a course in which the theory taken up in C. E. 1 and 2 is used in designing machine parts. These parts include bolts, journals, shafts, pulleys, gears, connecting and piston rods, and frame works of machines. Recitations and lectures only.

M. E. 9. Machine Design, Drawing:—The design of boiler and steam engine parts is worked out carefully in the drawing room. This course gives the student ample opportunity to apply the principles learned in M. E. 8. As in all other drawing courses, reliable and practical working drawings are insisted upon.

M. E. 10. Machine Design, Tools:—Design of jigs, fixtures, and other machine tools.

M. E. 11. Thermodynamics:—In this course a study is made of the properties of gases and vapors under different conditions, as applied to the steam and gas engine, air compressor and refrigerating machine.

M. E. 12. HOISTING MACHINERY:—The object of this course is to give the student an opportunity to apply the theory of M. E. 8 to a structural machine,—the design of columns, girders, ropes and sheaves is included.

M. E. 13. STEAM LABORATORY:—Some of the time allotted to this course will be spent in the university laboratory, but the course consists principally in testing engines, turbines, boilers, etc., in plants about the city.

M. E. 14. GAS ENGINES:—This is a course of lectures and recitations covering the various types of gas engines. It includes a study of gas engine operation, testing and installation.

M. E. 15. POWER PLANTS:—The arrangements, size and cost of the various units that are necessary in laying out a power house are here studied. Specifications for steam plants are also taken up.

M. E. 17. AUTOMOBILE DESIGN:—The principal parts that go into the automobile are carefully laid out, and working drawings made.

M. E. 18. STEAM TURBINES:—This course consists of lectures, recitations and problems covering the theory and construction of steam turbines. It includes a study of the principal points of both impulse and reaction turbines, such as nozzles, blades, etc., along with the commercial types. Efficiency and adaptability of turbines, as compared with other power producers, is an important feature.

M. E. 19. MARINE ENGINEERING:—A brief study is made of the engineering equipment of ships, such as types of engines, boilers, condensers, screws, paddle wheels, etc. The lake steamers will be considered principally.

M. E. 20. HEATING AND VENTILATING:—In this course a study is made of the methods employed in heating and ventilating residences, shops and offices. The various kinds of heating systems, as hot water, direct and indirect steam, and hot air, are studied. Typical plants in the city are inspected and discussed. Lectures will be given by prominent engineers.

CIVIL ENGINEERING.

C. E. 1. Mechanics of Engineering. Statics:—This course includes that part of mechanics dealing with bodies in equilibrium. It includes the study of forces and their composition and resolution by analytic and graphical methods; moments and the funicular polygon; the analysis of stresses in the simpler perfect frames. Friction and its laws, centers of gravity, the mathematical treatment of moment of inertia and radius of gyration and products of inertia. Suspended cables are also considered at length. *Six hours recitation per week.*

C. E. 2. Mechanics of Engineering. Dynamics:—This part of mechanics considers the subjects of velocity and acceleration in both rectilinear and curvilinear motion, simple harmonic motion; motion and force; translation and rotation; work, energy and power and their measurements. Dynamometers, kinetic friction, rolling friction, momentum and impulse. *Six hours recitation per week.*

C. E. 3. Strength of Materials:—The resistance of engineering materials to their loads by means of internal stress is studied in this course. The simple stresses and strains, tension members and short columns, torsion and shafts and springs, and the design of riveted joints are studied. In flexure the shears and moments are studied analytically, and by their diagrams, the strength and stiffness of beams are considered. Continuous beams and elastic deflection are studied by the geometrical treatment. Bending by oblique forces, combined torsion and bending, and other combined stresses. Long columns, their theory and the various empirical formulae used in design. Working stresses. *Five hours recitation per week.*

C. E. 4. Land Surveying:—The methods of land surveying as applied to ordinary surveys for boundaries and area and to differential and profile levelling are studied, special attention being paid to the geometrical basis of the various methods. The United States Public Land survey system is studied in detail. The adjustments of the transit and level receive particular attention, stress being laid upon them as applications of Descriptive Geometry. The computations of traverses and area, and the making of profiles and plotting are discussed in class and then performed by the student. *Three hours per week.*

C. E. 4a. Surveying Field Work:—The methods explained in C. E. 4 are applied in this course to actual surveys for area, traverses and simple levelling. Work within satisfactory limits of accuracy is required and neat field notes are insisted upon. *Six hours field work per week.*

C. E. 5. Advanced Surveying:—This course includes the theory of refined surveying methods as applied to city, topographical, bridge and marine surveying. Field astronomy and those methods of geodetic surveying applicable to plane surveying of high accuracy are also studied. *Three hours recitation per week.*

C. E. 5a. Surveying Field Work:—This course includes the field work illustrating the theory of C. E. 5. Part of the work is the complete topographic survey of a portion of the city and the mapping of it, showing all topographic and cultural detail. *Six hours field work per week.*

C. E. 6. Railroad Surveying:—The theory of reconnaissance preliminary and location survey is discussed with special reference to economic location. Simple, compound and reversed circular curves are studied and then the same curves are modified by easement curves of the common types. Switches, turnouts and yard layouts are designed in conformity with modern practice. Excavation and embankment are studied and calculated. Culvert and bridge foundations are staked out and waterway computed. The mass diagram for earthwork is also studied. *Three hours class work.*

C. E. 6a. Railroad Surveying Field Work:—The preliminary survey for a railroad about three miles long is made and mapped, a location and grade decided upon and the final location and earthwork staked out and computed. A final estimate of cost and accurate maps are required. Some time may be spent with the surveying parties of the railroads in the city. *Six hours field work.*

C. E. 7. Topographical Drawing:—A study is made of the various methods used in representing hydrography, surface relief and culture on maps, both in water color and by the pen. Formal lettering and neat title work are considered, and the best practice as shown in the maps of the various Federal surveys is followed as a guide. *Two hours class and seven hours drawing per week.*

C. E. 8. Hydraulics:—This is a study of the statics and dynamics of water. The flow of water through pipes, tubes and orifices, over weirs, and in conduits, channels and rivers is considered,—friction being given strict attention. The methods and instruments used in hydraulic surveys are studied, and practical surveys are made in the Detroit River. *Five hours recitation per week.*

C. E. 9. Hydraulic Machinery:—The dynamic pressure of water and its economic utilization in the various types of water wheels and water turbines are studied. The hydraulic ram, pumps and pumping machinery are also studied. *Three hours recitation per week.*

C. E. 10. Roof Trusses:—The analysis of stresses in roof trusses is continued from C. E. 1 and is supplemented by the graphical determination of stresses in the common types of roof trusses under both inclined and vertical loads. The drafting room work includes the complete design of a knee braced truss and of another simple frame. *One hour recitation and six hours drafting work per week.*

C. E. 11. Framed Structures:—The analytical and graphical methods used in determining the stresses in tension members, columns and beams of railroad bridges under the various distributed and concentrated loadings are thoroughly studied. *Five hours recitation per week.*

C. E. 12. Higher Structures:—This is a continuation of C. E. 11, with special reference to arches, draw spans, and special types of trusses. Camber and deflection are considered briefly. Steel framed buildings are analyzed and their stresses determined. *Four hours class per week.*

C. E. 13. Plate Girder Design:—This course calls for the complete design of a plate girder railroad bridge. *Six hours class per week.*

C. E. 14. Bridge Design:—In this course a pin connected railroad bridge of about 150 feet span is completely designed. *One hour recitation and six hours drafting work per week.*

C. E. 15. Masonry and Cement Theory:—The structural mechanics of the various kinds of masonry, the applications of masonry to foundations, voussoir arches, dams and retaining walls and the proper proportioning of concrete are considered in the class. In the drafting room a voussoir arch and a gravity retaining wall are designed and abutments for the bridges studied in C. E. 13 and C. E. 14 are designed. *Three hours class and six hours drafting work per week.*

C. E. 16. Reinforced Concrete:—The theory of reinforced concrete in general and the various commercial reinforcements in particular are studied, as well as their application to retaining walls, dams and the different types of beams, columns and flat slabs. *Three hours class per week.*

C. E. 17. Arch Design:—The special applications of reinforced concrete to the arch are considered in the class room and applied in the drafting room to the design of a practical arch. Designs are also made for a reinforced concrete retaining wall and a small reinforced concrete building. *Two hours class and six hours drafting work per week.*

C. E. 18. Water Supply:—The engineering features of a municipal water supply are studied and the student designs a supply system for a medium sized city. *Three hours class per week.*

C. E. 19. Sewerage:—The collection and removal of storm water and household wastes and the design of a practical system is studied in this course. *Two hours class per week.*

C. E. 20. Roads and Pavements:—The engineering and economic features of country and city road improvements is studied. *Three hours class per week.*

C. E. 21. Specifications:—A study is made of the various requirements of good typical specifications and the reasons for their inclusion. The student then writes specifications for structures or material that differs in detail from that studied in the class work. *Three hours class per week.*

C. E. 22. Civil Engineering Laboratory:—Tension, compression, torsion and bending tests of the various materials used in construction are made and the results checked against the theoretical values. Some time is spent on hydraulic testing and considerable time in the cement laboratory. *Six hours class per week.*

C. E. 23. Geodetic Surveying:—This course is given if sufficient students elect to take it. It will deal principally with the methods of geodetic surveying and the application of the Method of Least Squares to the adjustment of observations. *Two hours class per week.*

ELECTRICAL ENGINEERING.

E. E. 1. Direct Current Machinery:—In this course a partial review of that part of physics which deals with electricity is first taken up. This is followed by a careful study of the direct current motor, generator, the storage battery, etc. On account of the important part that electricity now plays in nearly every engineering project, this course is required of all students, and is made very thorough. The course consists of lectures, problems and recitations.

E. E. 1a. Direct Current, Laboratory:—Actual tests are made to determine the efficiency, performance, etc., of various types of direct current machines.

E. E. 2. Alternating Current Machinery:—The object of this course is to give the student a fair understanding of the alternating current and its many important applications. The motor, generator, converter, mercury arc rectifier and transformer are studied in detail.

E. E. 2a. Alternating Current Machinery, Laboratory:—Tests are made upon the various machines, both in the university laboratory, and in the power plants of the city.

E. E. 3. Electrical Machinery:—This course reviews courses E. E. 1 and 2, and takes up in greater detail the machines studied therein. Special study is made of the theory of the alternating current and its application. Operation of electrical machinery is an important item.

E. E. 4. Direct Current Electrical Design:—In this course the complete design is made of a direct current motor and an electromagnet. Practical working drawings are insisted upon.

E. E. 5. Electric Power Transmission:—The central electrical station, and long distance transmission lines are studied.

E. E. 6. Alternating Current Electrical Design:—This course is similar to E. E. 4, but considers only alternating machines, such as transformers, converters, etc.

E. E. 7. Electrical Railroads:—The aim here is to give the student a fair idea of the solution of the principal problems met in electrical railroads. These include the determination of power required by trains, methods of electrical transmission, arrangement of schedules, etc.

E. E. 8. Electrical Design:—The electrical part of the installation of a modern power house is designed. Details of the switchboards, conduits, generators and motor settings are made.

E. E. 9. Telephones:—A study is made of the theory of the electrical transmission of speech. Long distance and local systems are investigated. Time is given to the inspection of central stations, and wherever possible, lectures by telephone experts are given.

E. E. 10. Illumination:—A study is made of the theory of illumination, and the practical methods employed in furnishing light for streets and buildings.

E. E. 11. Electrical Laboratory:—Advanced experiments with electrical machinery, and the testing of machines. As far as possible these tests will be made in the electrical plants of the city.

MATHEMATICS.

1. Trigonometry:—Definitions and relations of trigonometric functions; logarithms; solutions of trigonometric equations. Determination of sides, angles and areas of right and oblique triangles in both plane and spherical trigonometry. Practice in the use of logorithmic and trigonometric tables, and solution of original problems.

2. Advanced Algebra:—Review of surds, imaginaries and quadratic equations and their geometrical representation. Special study is made of binomial theorem, permutations and combinations, convergence and divergence, theory of equations, partial fractions.

3. Analytical Geometry:—The object of this course is to familiarize the student with analytical methods of investigation; representation of the straight line, circle, parabola, ellipse and hyperbola by means of equations. A short time is devoted to solid analytic geometry.

4. Differential Calculus:—A very thorough course in differential calculus is given, including variables, functions and limits, differentiations, maxima and minima, radii and centers of curvature and tracing of curves.

5. Integral Calculus:—Methods of integration as applied to finding of areas, volumes, length of curves, and moments of inertia.

CHEMISTRY.

1. Elementary Inorganic Chemistry:—A study of the occurrence, preparation, physical and chemical properties of metals and non-metals. Their use and application in the arts. Symbols and equations. Laws of definite and multiple proportion. Equivalent, molecular and atomic weights. Oxidation, reduction, decomposition, dissociation, ionization and hydrolysis.

2. Inorganic Chemistry:—A thorough study of metals and non-metals, their classification, their use in engineering problems. Kinetic molecular hypothesis. Theory of solution and dissociation. Colloids, hydrosols and hydrogels. Chemical equilibrium, ionization and the interaction of ionic substances. Ionic theory of precipitation and solution, complex ions.

1a and 2a. Chemical Laboratory:—A selection of experiments will enable the student to familiarize himself with the elements and compounds, but especially fit him to attack the problems that may present themselves to the practical engineer.

3. Qualitative Analysis:—Analytical actions, separations and identifications in the light of modern theories of ionic solution and equilibrium.

3a. Qualitative Laboratory:—In the laboratory, selected reactions and separations which exercise the observational and reflective powers of the student, whilst giving the technical knowledge necessary to discover the constituents of simple alloys, ores and minerals.

4. Quantitative Analysis:—Determination of exact amount of each of the different constituents in any compound. Gravimetric and volumetric. Elective.

5. Organic Chemistry:—Introduction to the carbon compounds and their principal derivatives. Elective.

6. Metallurgy:—Fuels and other means of obtaining high temperatures: Furnaces and their accessories. Treatment of the principal iron ores. Metallography.

GENERAL PHYSICS.

Instruction in Physics is given by lectures illustrated by numerous demonstrations and by recitations from lessons assigned in a text-book. The object of the course is to acquaint the student with experimental facts, as well as with the quantities used in Physics and the theory and method of calculation. Particular attention is given to the fundamental principles and the solution of problems of a practical nature. A special effort is made to adapt the course to the needs of technical students. For this reason most of the time will be given to such subjects as are correlated to later technical work.

The course includes the treatment of the mechanics of solids, liquids and gases; heat, sound, light, magnetism and electricity.

Laboratory Physics: The laboratory experiments are intended to give the students,—not only a practical knowledge in the use of standard apparatus, and training in the methods of making and recording physical measurements,—but also a firmer grasp and clearer insight into the physical laws and phenomena. More stress is laid on the grasp of principles and personal resourcefulness on the part of the student than on mere skill in following a set of directions. The student is required to keep an accurate and detailed record of every experiment performed. The work required is not only accurate, but as far as possible, individual,—and great importance is laid on the discussion of the sources of error.

Experiments in the branches of the different subjects are selected from laboratory manuals of Ames & Bliss, Stewart & Gee, Miller, Millikan and others. Accurate measurements of length, mass and density, by means of comparator, cathetometer and balance; the determination of the constants of gravity, inertia and elasticity; calorimetric measurements; the use of the spectroscope, spectrometer, polariscope, and grating; determination of the velocity and pitch of sound; magnetic and electrical measurements are among the more important exercises.

ECONOMICS.

Introductory: Definitions.—Political Economy, Economic Laws. Economic goods, positive and negative. Personal goods. Wealth. Consumable and productive goods. Value, individual and social. Exchange. Price, cost, labor. Income. Capital. Expenditure.

Production. Productive capacities of the Earth. Two factors of Production. Points of Physical Geography. Important conclusions. Limitations of Earth's Resources. Intensity of Production. Law of Diminishing Returns. Suitable Degree of Intensity.

Productive powers of man. Variations depending on race, nationality, morality. General and technical education.

Industrial Organization. Nature, varieties, extent, advantages, drawbacks; physical, moral, economic. Misconception on division of Labor and Machinery.

Industrial Progress. Meaning and kinds. Historical Survey. The Industrial Revolution. Its effects. False explanation of unsatisfactory conditions today. The true explanations.

Industrial Locality and Dimension. Conditions and Advantages of Localization. Growth of Cities. Industry and Business. Varieties of large and small scale Industries. Advantages and Drawbacks of large and small. History of co-operation.

Consumption. Meaning of Consumption. Limits of human wants. Theory of marginal value. Absolute and conventional necessaries. Standard of Life. Superfluities and Luxuries. Food: What it embraces. Famines and their prevention. The Housing Problem in modern cities. Fuel and Light. Clothing and Adornment. Furniture. Medical Expenditure. General Education. Religious Expenditure. Cost of Justice and of Recreations.

Population and Subsistence. Malthusianism. Declining Birthrate. Increasing means of Substance. Extravagance. Unused Resources. Colonization. Malthusianism and Providence.

Exchange. Reasons for Trade. Market Prices. Monopoly Prices. Different kinds of Monopoly. Why Monopolies exist. The Proper Remedy for the Evils of Monopoly. Differential gains and the factors producing them. Their Capitalization. International Trade. Its Nature, Advantages and Drawbacks. Free Trade versus Protection.

Money: Need and Nature of Money. Kinds of money at different periods. Token Money. Credit. Different kinds and uses of banks. The Clearing System. Commercial Use of Securities. International Exchange. Use and Abuse of Commercial Credit. Uncommercial Credit and its Dangers.

Distribution. Profits: Rate, Amount, Real, Nominal, Hiddenness of. Mobility of Labor and Capital as tending to equalize Profits. Interest, meaning and kinds. Rate and amount. Reasons for varying rate. Mobility of Labor and Capital as affecting rates of. Wages: rate and amount, real and nominal, maximum and minimum. Wages and Cost of Living. Pessimist and Optimist Wage-theories. Riches and Poverty from the economical and ethical standpoint. Wisdom and folly of the War on Riches; Communism, Anarchism, Socialism, Collectivism, Socialization of Land.

ENGLISH.

FRESHMAN.

The first year's English consists of a brief review of the principles of rhetoric with special attention to the theme and paragraphic unit. Theme writing is begun at once with special emphasis upon a clear and concise expression of thought. The student is soon required to write reviews of leading articles in current scientific periodicals, the aim constantly being to obtain a natural and exact expression of thought.

One hour per week is spent in text book study, which also comprises a study of English and American masterpieces, and one hour per week is given to theme work, as noted above, throughout the freshman year. (Courses Eng. I. and Eng. II.)

Unless the student already possesses a literary education, he is also required to do a certain amount of outside reading. This reading comprises works of poetry, fiction, essays, history, biography and science.

READING REQUIRED OF FRESHMAN STUDENTS.

The following course of reading is required of all freshmen in this department. The object of the requirement is to supplement the regular class work by giving the student examples of well-rendered thought, as presented by the best writers in the several departments of literature.

Such literature, when earnestly read, will also necessarily broaden the student's knowledge and stimulate his powers of thought and expression.

Each student should read, during the academic year, as many books from the following lists as will give him a total credit of 75 points. Students having credit in college literary work will be credited for such work, and will not be required to do the full 75 points of reading.

I. SCIENCE.

FISHER, MRS. A. B.: A Short History of Natural Science, (25).
NEWCOMB, SIMON: Astronomy for Everybody, (25).
CLERK, AGNES: History and Astronomy in the 19th Century, (25).
WASMANN: Modern Biology and Evolution, (25).
WALSH, J.: Thirteenth Greatest of Centuries, (20).
NORTON: Elements of Geology, (20).
CHAMBERLIN AND SALISBURY: College Geology, (20).
FOURNIER: Electron Theory, (20).
SNYDER, CARL: New Conceptions in Science, (20).
FRANKLAND, P. F.: Our Secret Friends and Foes, (20).
PROCTOR, R. A.: Other Worlds Than Ours, (20); Light Science for Leisure Hours, (10).
BYRN, E. W.: Progress of Inventions in the Nineteenth Century, (20).
SHALER, N. S.: Nature and Man in America, (20); Man and the Earth, (15).
LUBBOCK, J.: Scientific Lectures, (20).
DUNCAN, R. K.: The New Knowledge (Radium, Etc.), (15).
THOMPSON, S. P.: Light, Visible and Invisible, (15).
RUSSELL, I. C.: Lakes of North America, (15).
ILES, G.: Flame, Electricity and the Camera, (15).

Mendenhall, T. C.: A Century of Electricity, (15).
Gerard: Old Riddle and Newest Answer, (15).
McCullough, E.: Engineering as a Vocation, (10).
Talbot, F. A.: Railway Conquest of the World, (10); Steamship Conquest of the World, (10).

II. History and Biography.

Fiske, John: American Revolution, 2 vols., (40); Discovery of America, 2 vols., (40); Beginnings of New England, (25); Old Virginia and Her Neighbors, 2 vols., (40).
Grant, U. S.: Personal Memoirs, 2 vols., (40).
Lee, Sidney: Great Englishmen of the Sixteenth Century, (25).
Creasy, E. S.: Fifteen Decisive Battles of the World, (20).
Rawson, E. K.: Twenty Famous Naval Battles, (20).
Macaulay, T. B.: History of England, Vol. I., Chap. 3, (10).
Harcourt, L. F.: Vernon; Achievements in Engineering, (20).
Moffett, Cleveland: Careers of Danger and Daring, (20).
Cochrane, C. H.: Wonders of Modern Mechanism, (20).
Cochrane, Robert: Romance of Industry and Invention, (20).
Church, W. C.: Life of John Ericcson, (20).
Smiles, S.: Lives of George and Robert Stephenson, (20), and of Bolton and Watt, (20), in "Lives of the Engineers."
Thompson, S. P.: Michael Faraday, His Life and Work, (20).
Bryce, J.: American Commonwealth, (20); Hindrances to Good Citizenship, (20).
Coolidge, A. C.: The United States as a World Power, (20).
Cattell, J. M.: American Men of Science, (20).
Garnett, W.: Heroes of Science: Physicists, (20).
Jordan, D. S.: Leading American Men of Science, (20).
Muir, J.: Heroes in Science: Chemists, (20).
Parton, J.: Captains of Industry, (20).
Jones, F. A.: Life of Thomas Edison, (20).
Vallery-Radot: Life of L. Pasteur, (20).
Morse, J. T., Jr.: Life of Abraham Lincoln, (20).
Thorpe, T. E.: Humphrey Davey, Poet and Philosopher, (20).
Brewster, Sir David: Life of Sir Isaac Newton, (20).
Clerke, Miss A. M.: The Herschels and Modern Astronomy, (20).
Glazebrook, R. T.: James Clerk Maxwell, (20).
Franklin, Benjamin: Autobiography, (10).

III. Fiction.

Bulwer-Lytton, E. L.: The Last Days of Pompeii, (25).
Dickens, Charles: A Tale of Two Cities, (20); David Copperfield, (20).

SCOTT, WALTER: Woodstock, (20); Guy Mannering, (20); Kenilworth, (20); Quentin Durward, (20); Waverly, (20).
STEVENSON, R. L.: Kidnapped, (20).
HAWTHORNE, NATHANIEL: The House of Seven Gables, (20).
COOPER, J. F.: The Pilot, (20); The Spy, (20).
ALLEN, JAMES LANE: The Reign of Law, (20).
KIPLING, RUDYARD: Captains Courageous, (15).

IV. ESSAYS AND POETRY.

LAMB, CHARLES: Essays of Elia, (25).
DANTE: Inferno, Norton's Translation, (25).
HOMER: Iliad, (25); Odyssey, (25).
TENNYSON, ALFRED: In Memoriam, (20); Maud, (20).
BROWNING, R.: Pippa-Passes, (10); A Soul's Tragedy, (20); Strafford, (20).
SHAKESPEARE: Hamlet, (15); Othello, (15); The Merchant of Venice, (15); Macbeth, (10); The Tempest, (10); King Lear, (10); Twelfth Night, (10).

V. MISCELLANEOUS.

HOLAIND: Ownership and Natural Right, (20).
RYAN: A Living Wage, (20).
SCOTT, W. R.: The Americans in Panama, (20).
CLARK, F. E.: The Continent of Opportunity, (15).
ROOSEVELT, T.: The Winning of the West, (15).
DEVAS: Key to the World's Progress, (15).
BATES, A.: Talks on Writing English, (15).
GREENOUGH, J. B. AND KITTREDGE, G. L.: Words and Their Ways in English Speech, (15).
LOUNSBURY, T.: Standard of Usage in English, (15).
CARRINGTON, T. S.: Fresh Air and How to Use It. (10).
OLIVER, T.: Diseases of Occupation, (10).
WILEY, H. W.: Foods and Their Adulteration, (10)

SOPHOMORE.

The second year continues the theme work, but a large share of the subject matter is furnished by the student's shop experiences and by inspections of the many engineering problems and constructions, which only a large city can furnish. The student is encouraged to observe and to express in scientific language what he has seen. Here also the study of English and American masterpieces is continued. (Courses Eng. III. and Eng. IV.)

The Junior and Senior Years continue the study of English as shown in the course of study. Twelve hours of English are required to satisfy the requirements for graduation, but beginning with the Junior year, the course will be largely determined by the efficiency and needs of the class. The course will constantly aim at stimulating careful observation and logical thinking, which form the basis of clear expression.

MODERN LANGUAGES.

This course at present offers German only. Twelve hours are required to qualify for graduation from each course offered in the Engineering Department.

The object of the German courses is to give the student a working knowledge of reading, writing and speaking,—with special emphasis upon comprehensive reading. The medium of class communication is changed from English to German as early as is practicable.

The first year is devoted to German grammar, which is taught by the direct method, and enough theme writing and classic reading to acquire a reasonable knowledge of German idioms, constructions and methods of thought. (Courses German I. and German II.)

The second year is devoted to reading and translation of German technical works on scientific and engineering subjects.

These subjects are chosen with a view to furnishing the student with a knowledge of the nomenclature of Chemistry, Physics and such mechanical sciences as lie within the general scope of the profession of engineering. (Courses German III. and German IV.)

Students offering German as one of their entrance requirements may take the second year's technical German for part of their language credits.

LAW OF CONTRACTS.

CONTRACTS:—Two hours each week throughout the year. The topics of offer and acceptance, consideration, assignment of contracts, contracts for the benefit of third persons, joint obligations, contracts within the Statute of Frauds, express and implied conditions, impossibility, contracts in restraint of trade, illegal contracts, novation, release, accord and satisfaction, arbitration and award, alteration and merger. Williston's Cases on Contracts, Vols. I. and II.

CO-ORDINATION.

C.1 to C.9: These courses consist of two class periods per week at the university. The students from the various shops are brought together into one class, and their difficulties and experiences are discussed. From time to time shop superintendents and foremen are invited to send in problems and questions arising in their daily work. These, as far as possible, are worked out by the faculty engineers and students, and the class-room is made a sort of clearing house for knowledge. Whenever any subject is under consideration, such as shop management, power transmission, routing of work, limits of accuracy, feeds and cuts of machine tools, overhead costs, time keeping systems, etc., the students discuss the methods followed in the different plants. In this way a very broad idea of the work carried on in the several shops is brought to each student.

Shop mathematics, methods of setting up and doing different operations on the machines and at the bench are studied. Tables for curves are worked out for simplifying such work as cutting tapers, threads, feeds and speeds, etc. The student will, from time to time, be expected to write reports on what he has observed in the shop, and read them before the class.

INSPECTION TRIPS.

Detroit offers great opportunity for visiting engineering plants of all descriptions. Among the works inspected are electric lighting, shipbuilding, automobile, railroad car, stove, steam engine, blower, and bridge companies. The material for many of the themes for the English courses will be taken from these trips.

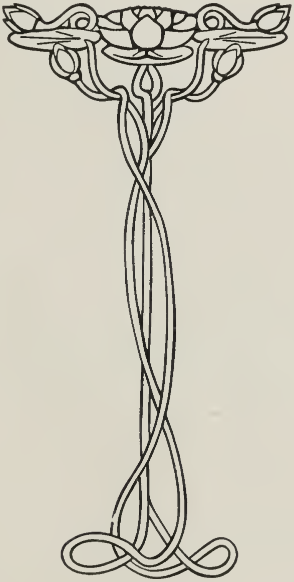
DIRECTORY.

The President, William F. Dooley, S. J.
University of Detroit, Detroit, Michigan.

The Dean, Department of Arts, William T. Doran, S. J.,
University of Detroit, Detroit, Michigan.

The Dean, Department of Engineering, J. R. McColl,
University of Detroit, Detroit, Michigan.

The Dean, Department of Law, Judge George S. Hosmer,
University of Detroit, Detroit, Michigan.



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Calendar

1916

June 1 to Sept. 12—Registration and Assignment to work in Shop Department (See page 16).

Sept. 12, Tuesday—Registration Day.

Sept. 13, Wednesday—Classes begin at 8 A. M.

Nov. 30 to Dec. 2, Thursday to Saturday—Thanksgiving Recess.

Dec. 23, Saturday—Christmas Recess begins.

1917

Jan. 8, Monday—Classes resumed.

Feb. 12-17, Monday to Saturday—First semester examinations for Section A.

Feb. 26 to Mar. 3, Monday to Saturday—First semester examinations for Section B.

Apr. 5, Thursday—Easter Recess.

Apr. 11, Wednesday—Classes resumed.

July 9 to 14, Monday to Saturday—Final examinations for Section A.

July 23 to 28, Monday to Saturday—Final examinations for Section B.

June 1 to Sept. 10—Registration in Shop Department (See page 16).

Sept. 11, Tuesday—College year begins.

Faculty

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WILLIAM T. DORAN, S. J.,
President of the University.

JAY R. MCCOLL, B. S.,
Dean.

HARRY E. PRESSINGER, M. E.,
Assistant Dean.

ARTHUR G. BIERMA, M. E.,
Professor of Mechanical Engineering.

THOMAS L. K. DONNELLY, C. E.,
Assistant Professor of Civil Engineering.

ALEXANDER DOW,
Lecturer in Electrical Engineering.

JOHN B. FROEBES, S. J.,
Professor of Mathematics and German.

ALOYSIUS F. HEITKAMP, S. J.,
Professor of Chemistry.

GEORGE J. LIEBER,
Lecturer on "Accident Prevention."

JAMES MCCABE, S. J.,
Professor of Economics.

LOUIS A. OFFER, B. M. E.,
Co-ordinator of Shopwork.

EDWARD J. POSSELIUS, B. S.,
Assistant Professor of Electrical Engineering.

WILLIAM J. THOME, B. S., C. E.,
Professor of Civil Engineering.

JOSEPH WILCZEWSKI, S. J.,
Professor of Physics and Electricity.

WILLIAM P. WINCH,
Professor of Contracts.

FLORENCE DONOHUE,
Registrar.

General Statement

This institution was incorporated April 27, 1881, according to the general law of the State of Michigan under the corporate title of "Detroit College," with power to grant such honors and confer such degrees as are usually conferred by similar colleges and institutions of learning in the United States. On January 10, 1911, the corporate title was changed to that of

"UNIVERSITY OF DETROIT"

The University buildings are located on Jefferson Avenue, less than one-half mile from the heart of the city and easily accessible to all street car lines.

ENGINEERING COURSE

The course in engineering offered by the University of Detroit differs from the usual courses in engineering by following what is known as the co-operative plan, whereby the university works in direct contact with the manufacturing plants of the city,—namely, the student spends alternate two weeks in the class-rooms and in the shops.

This departure is a result of the realization of the fact that industrial education, given in direct contact with the environments where it is afterwards to be applied, will train more efficient and skillful engineers than a course in which the practical application of the theories of the class-room is principally confined to the shops and laboratories of the university. The course, therefore, makes theory and practice go hand in hand. The student, during his course, covers all the subjects which are taught in approved engineering schools, while he is experiencing the practical side of his profession in the field where that profession is later to be exercised.

There is no longer question of the practicability of this plan. Experience has already proven it both here and in other industrial centers. Wherever students are employed in the shops under the co-operative plan, manufacturers have given their approval of the system and have been ready to accommodate in their plants a great number of such students.

The students find the combination of practical work and theory less of a strain, and derive more benefit from the plan than by continuous application to class-room work.

Located as the school is, in a great industrial center, it is easy to understand how experience in every possible variety of engineering work is open to the student. The list of co-operating plants, which may be found on another page of this announcement, shows plainly how ample are the possibilities of learning in actual practice the principles of mechanical, civil and electrical engineering.

New Engineering Building

The New Engineering Building, which is situated on the south side of Jefferson Avenue, directly opposite the main building of the University, was formally opened with a banquet at the Board of Commerce Auditorium November 30th, 1915.

It is a fireproof structure of four stories and basement, built of reinforced concrete. The front is of Bedford limestone, carrying out the design now embodied in the main building of the University.

As may be seen from the floor plans shown on pages 11 and 12, the general outline of the building represents a huge block letter I. It has a frontage of 100 feet on Jefferson Avenue and extends back to Woodbridge Street 200 feet.

The front section of the first floor is devoted entirely to lobby and offices. The lobby separates the Dean's and President's offices. On either side of the back part of the lobby, stairs lead to the floors above, while directly in the rear is located a passenger elevator.

The two rear sections of the first floor are devoted to the mechanical, civil and electrical laboratories.

The second floor is given over to recitation rooms, drawing rooms and lecture halls. On the third and fourth floors are located the Physics and Chemistry Departments. These floors also furnish ample accommodation in spacious lecture and recitation rooms.

MECHANICAL LABORATORY

The Mechanical Laboratory is especially designed to give a very broad and up-to-date course in the testing and operating of all types and models of steam, gas and water power machinery. The floor is of concrete construction, and is provided with inserts which insure a rapid setting up of engines and other apparatus, in almost any position desired. Openings are also provided through which the steam, gas and water pipes, electrical wires, etc., may be brought up from the basement and connected closely to the machine to be tested.

The boiler room, which is located in the southeast corner, is designed with ample ceiling height and area to accomodate almost any type of boiler. Space is provided here for gas producers, pumps, weighing tanks, etc., and is therefore part of the general steam laboratory. A mezzanine is located above the boiler space.

ELECTRICAL LABORATORY

For the testing of electrical apparatus a space 100 x 25 feet has been allotted. Two hollow concrete benches have been provided, upon which the motors, generators and other apparatus will be mounted. At each machine a terminal board is installed and is electrically connected by means of wires inside of the benches to a main distributing board located at the end of the motor benches. At the board connections may be made to the main power lines, resistances or instruments.

CIVIL ENGINEERING

The cement laboratory is fully equipped for making all the standard tests of cement. The testing machines of the materials laboratory are to be placed in the forward part of the electrical laboratory, while the hydraulic laboratory is to be installed on the mezzanine floor overlooking the boiler room. A complete equipment of surveying instruments, rods, tapes, etc., are available for the use of the classes in surveying, astronomy and hydraulics. The light courts will be reserved for the building of beams and setting up of segments of floors.

Acknowledgments

In connection with the new building, the faculty wish to express their gratitude to all those who have in any way assisted by donations of money or equipment or by personal service.

The leading benefactors to date are:

John and Michael Dinan	$93,000
Edward H. Doyle	5,500
M. W. Dillon	5,000
The James Dwyer Family	5,000
George L. Fleitz, a bequest	5,000
Fred T. Moran	2,000
The E. J. Hickey Family	1,000
Joseph A. Hinsberg	1,000
Charles L. Palms	1,000
Michael Sullivan	1,000

Many smaller donations ranging from $10.00, as also furnishings and equipment are gratefully acknowledged.

Mr. John A. Russell deserves our sincerest thanks for his efforts to equip the laboratories. Several of the machines listed below came through his solicitation, also for gift of a steam engine.

Mr. Frank Wilks Brooks, General Manager of the Detroit United Railway, 20 kilowatt turbo-generator unit.

Mr. A. F. Knobloch, General Manager of the Northway Motor Company, Detroit, has promised to keep in the physical laboratory examples of the current types of automobile motors.

Mr. William J. Newbrough, President of the New-Way Motor Co., Lansing, Mich., gasoline engines for operative and demonstrative purposes.

Mr. F. E. Fisher and Mr. Leslie Clyde Smith, of the Detroit Electric Welder Co., electric welder.

Mr. Charles E. Kolb, Union Steam Pump Co., Battle Creek, Mich., steam pump.

Mr. John Trix, of the American Injector Company, Detroit. Examples of injectors and ejectors for steam boiler practice.

Mr. M. D. McNamara, all the varnish and filler used in the building.

Mr. Leon Coquard, President Michigan Chapter A. I. A., Journal of the American Institute of Architects, for the library.

Mr. Alex. Dow, of the Edison Illuminating Company, Detroit, complete motor-generator set, a complete set of the proceedings of the National Electric Light Association for the library.

Mr. Samuel Edward Wolff, of Hodenpyl, Hardy & Co., New York City, a complete set of the proceedings of the American Gas Institute for the library.

Detroit Brickmakers' and Manufacturers' Association, the complete engineering literature of clay-working for the library.

Mr. Arthur T. Waterfall, Detroit, Mich., literature on tests and standards for iron and steel working.

Mr. Emerson McMillin, President of the American Light & Traction Co. of New York, donated two annual scholarships in the engineering department to continue for five years.

Messrs. Wickes Brothers, Saginaw, Mich., a substantial courtesy.
Mr. Charles Downey, President of the Reliance Engineering Co., Lansing, Mich., gasoline engines.

Mr. James H. Livsey, of the General Electric Co., Detroit, Mich., portrait of Thomas A. Edison.

Detroit Engine Works, gas engine.

Mr. John H. Barlow, "American Machinist."

Mr. Maurice Black, Balopticon for microscopic projection, Asst. Certified Thermometers, etc.

Mr. H. C. Deckard, "Deckard Handbook of Shop Mathematics."

Mr. Louis A. Offer, Mineral Collection.

Mrs. F. F. Palms, Drawing Instruments.

Mr. W. S. Pike, Platform Scales.

Mr. Adolph Singelyn, Electric Motor.

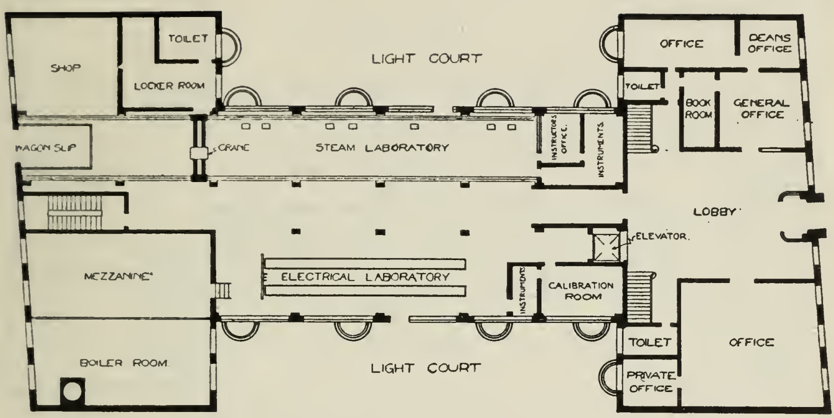
Mr. Leo Sunday, Electrical Supplies.

Hydrated Lime Bureau, several handbooks.

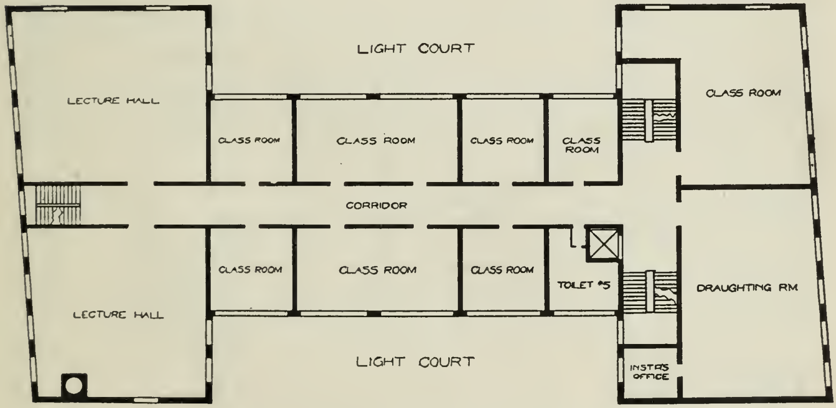
Globe House Furnishing Co., two mahogany chairs.

Mr. James F. Murphy, twelve oak and ten mahogany office chairs.

Universal Portland Cement Co., a number of pamphlets.

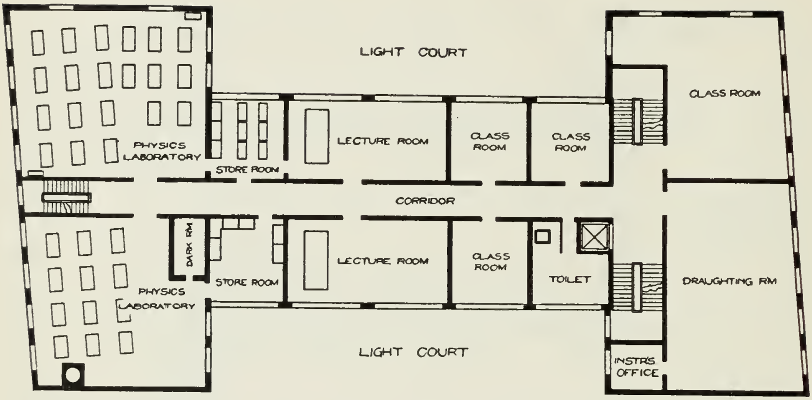


FIRST FLOOR PLAN

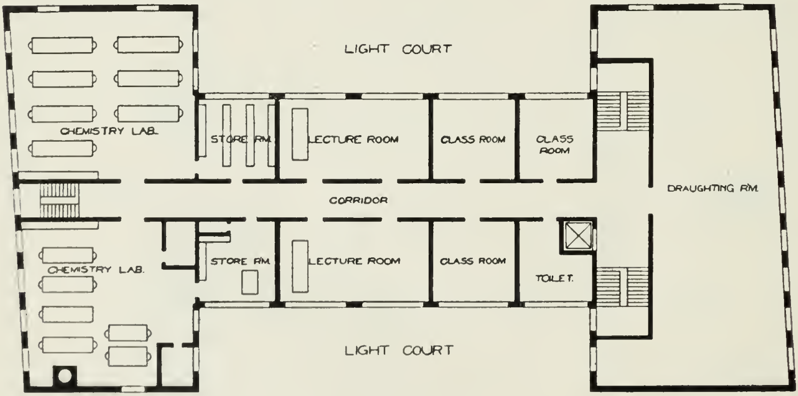


SECOND FLOOR PLAN.

FLOOR PLANS OF THE NEW ENGINEERING BUILDING.



THIRD FLOOR PLAN.



FOURTH FLOOR PLAN.

FLOOR PLANS OF THE NEW ENGINEERING BUILDING.

CO-OPERATIVE SYSTEM.

The co-operative system of combining theory and practice is carried on as follows:

The student is placed at work in a machine shop, drafting room, or with a surveying or construction party,—depending on the course he has chosen,—for about half of the time allotted to the course, while the other half is spent in the university class-rooms.

The system is put into practical operation by dividing the class into two equal sections. One section is placed at work in the shops (the term "shops" in this bulletin means the place of the student's practical employment) and the other section takes up its work in the class-room. At the end of each two weeks the sections are reversed. To every position in the shops, two students are assigned. In this way the employer's machine and equipment, allotted to the co-operative students, are in constant use.

These shop positions at the co-operating plants are secured by the university and belong to the university,—thus the students are relieved of all responsibility of securing positions for themselves. This arrangement relieves the student of all care and uncertainty in seeking employment, and enables the university to grade the student's work at the shops.

ADVANTAGES OF THE PLAN.

Experience is showing more clearly every day that in the training of an engineer the practical side of his profession should be strongly emphasized. The profession is nothing, if not practical. For this reason, it is not sufficient to confine the student's time and energy to the analysis of mathematical and scientific theories and the explanation of principles governing the different departments of engineering, but his training must be in the field of practical application of theory. The laboratory has failed in the past to impart the full training requisite for the engineer.

The need of this practical training is openly acknowledged by deans and professors of engineering schools throughout the country. They usually advise their students to don the overalls immediately after graduation. Whatever the reason may be, this advice is not always followed, and we more often find engineering graduates in the drafting room or business office rather than in the machine shop or on the girders of a bridge or building. In our system, work in mechanical, civil and electrical construction is part and parcel of the course.

A second advantage consists in the fact that the positions held by the students pay from 10 to 25 cents an hour, depending upon the efficiency of the student, thus enabling him to pay part of his expenses. Therefore a student can defray his expenses while at school to the extent of from $14.00 to $25.00 per month. When calculated at the end of the school-year, it will be found that a student has earned at the shops enough to cover the expenses of tuition, matriculation, laboratory fees and books.

A third advantage is that a student need not complete an entire engineering course only to discover, when he has worked for a while in some field of engineering, that he has adopted a profession not in keeping with his tastes and ability. By the co-operative arrangement it is possible for the student to come very early to a conclusion, because he immediately finds himself under actual working conditions and is thrown into contact with practical engineers.

A fourth advantage consists in the fact that the student has the opportunity to display before employers whatever talent and ability he may possess, and thus it is made easier for him to find employment after graduation. Often students are offered positions early in their course, and can begin, even in the first or second year, to specialize in the theory requisite for these positions.

A fifth advantage is the fact that the student is working from eight to ten hours a day with a class of men who do the detail work in engineering operations. He learns habits of industry that will prove invaluable, and he gets a view of work from the shopman's standpoint.

CO-OPERATIVE PLANTS.

The following are the plants co-operating with the University of Detroit.

Aluminum Castings Co.
American Blower Company
American Car & Foundry Co.
American Pattern Works
Bryant & Detwiler Co.
Burroughs Adding Machine Co.
Crystal Washing Machine Co.
Detroit Shipbuilding Co.
Detroit Stove Works
Detroit Twist Drill Co.
Detroit United Railway
Eastern Pattern & Construction Co.
Edison Illuminating Co.
Federal Motor Truck Co.
Gemmer Manufacturing Co.
General Motors Company
Great Lakes Engineering Co.
Harrigan and Reid Co.
Johnson, Larson & Co.
Lauer Machine Co.
Lennane Bros.
Michigan Central Railroad Co.
Michigan State Telephone Co.
Michigan Stove Works
Motor Truck Body Co.
National Twist Drill Co.
Northern Engineering Works
Packard Motor Car Co.
Parke, Davis and Co.
James W. Partlan Co.
Peninsular Stove Works
Phillips, Wilcox & Kruse
Russel Wheel and Foundry Co.
Solvay Process Co.
United States Tire Co.
W. E. Wood Co.

In securing the co-operation of the foregoing companies the university has been careful to select those plants where a general class of work is carried on. It has favored machine shops that require the skilled machinist, rather than the machine hand who repeats over and over again certain operations. An examination of the list will disclose the fact that plants have been favored which turn out large units, such as cranes, steam engines and heating systems, and also those which have machine shops for the manufacture and repair of their own equipment.

When assignments are made to plants engaged in turning out a great number of the same product, such as an adding machine or automobile, arrangements are made whereby the student is shifted from machine to machine and from department to department as fast as he learns the operations. Railroads in and about Detroit, construction companies, electrical plants and power houses, each in its own particular line of engineering, give ample opportunities to the earnest student to specialize in civil or electrical engineering.

CO-ORDINATOR.

The shop department is under the supervision of a co-ordinator who is a graduate engineer and a journeyman mechanic. He divides his time between the shop and the university. He makes the rounds of the shops where the students are employed and familiarizes himself with the conditions, and keeps an accurate record of each student's progress. At the university he presides over what is known as the co-ordination class, where shop problems are discussed. Furthermore, his duty is to act in an advisory capacity to the professors of mechanics, mechanisms, machine design, strength of materials, etc., in order that problems which the students have encountered in their practical experience may receive more detailed exposition.

REQUIREMENTS FOR ADMISSION.

Candidates for admission must be at least seventeen years of age. They must either present a certificate of graduation from an accredited high school, or give evidence of having satisfactorily completed an amount of preparatory study represented by fifteen units, as explained below. A unit represents a year's study in any subject in a High School, assuming that the length of the school-year is from thirty-six to forty weeks, that a period is from forty to sixty minutes in length, and that the study is pursued for four or five periods a week.

The units presented must include the following:

English	3 units
Algebra (through Quadratics)	1 unit
Geometry, Plane	1 unit
Geometry, Solid	½ unit
Physics	1 unit
History	1 unit
Language	1½ units
	9 units

The remaining six units may be selected from the following list:

Manual Training	2 units	Chemistry	1 unit
Drawing	1 or 2 units	Trigonometry	½ unit
Civics	½ unit	German	2 units
History	1 unit	French	2 units
Astronomy	½ unit	Spanish	1 unit
Geology	½ unit	Latin	2 units
Physical Geography	½ or 1 unit	Greek	2 units
		English	1 unit

Candidates for admission who have no deficiencies should fill out entrance blanks (which may be obtained from Registrar) and have them signed by the principal of the school where credits were earned.

Those who have deficiencies must have their entrance blanks in the office of the university by August 14th.

Examinations for admission will be held from August 25th to August 31st.

Students who lack credits in subjects other than Algebra through Quadratics, Plane and Solid Geometry may enter the regular course on condition that they make up lacking credits during the first year.

If a diploma is not presented, evidence of honorable dismissal must be given from the preparatory school or college last attended.

MATRICULATION.

Matriculation in the engineering department may be made between June 1st and September 12th. Candidates who decide to enter this department should communicate with the dean of the department as early as possible. They should make an exact statement as to fitness to satisfy entrance requirements. The university wishes applicants to enroll as soon as possible, in order to give them some weeks of practical experience at the shops before the opening of classes. Candidates who enter early, not only have the benefit of more shop experience, but the additional advantage of securing better positions.

SPECIAL STUDENTS: Persons wishing to do university work in engineering will be admitted to classes as special students on payment of special fee. Should such students afterwards desire to apply for a degree, they must first satisfy all the entrance requirements.

ADVANCED STANDING: Candidates who have successfully carried on any of the subjects given in this course may apply for advanced standing to the professor in charge of that particular course. Application for advanced standing should be made within the first three class weeks of each semester.

DEGREES.

The degree of Bachelor of Civil Engineering, (B. C. E.) Bachelor of Mechanical Engineering, (B. M. E.) and Bachelor of Electrical Engineering, (B. E. E.) will be given to students who have satisfactorily completed the five year course mapped out on the following pages.

TERMS IN THE ENGINEERING COURSE.

A matriculation fee of $5.00 is paid by all students of the university before entering upon any course and entitles them to permanent membership in the university.

Regular students in the engineering department pay an annual tuition fee of $100.00, payable in two equal installments, one before the beginning of each semester. No fees will be refunded.

Students entering before the beginning of the first semester, (Sept. 12th) must pay their matriculation fee and $25.00 (one-half of the first semester's tuition) before taking up their shop-work. The remaining $25.00 must be paid at the beginning of the semester, Sept. 12th.

Special students will be charged a fee of $3.00 per credit. A credit, as explained later, is the equivalent of one class period per week for one semester. The credit value of each course is given in the Schedule of Studies.

A laboratory fee of $5.00 will be charged for each semester's course in the physical, chemical, mechanical, civil and electrical laboratories, and a surveying fee of $3.00 for each semester's course. A small deposit for breakage will also be required in these courses.

For Freshman students the expenses are somewhat higher than for those in the other classes, due to the fact that the drawing equipment is purchased the first year.

Below is given a list of the expenses directly connected with the course:

FIRST SEMESTER.

Matriculation fee	$ 5.00	
Tuition fee	50.00	
Laboratory fee	5.00	
Drawing instruments	15.00	
Drawing material	4.50	
Books	7.00	
Locker fees	.50	
		$87.00

SECOND SEMESTER.

Tuition fee	$50.00	
Laboratory fee	5.00	
Books	4.50	
Locker fees	.50	
		$60.00

The succeeding years will average for *each semester* as follows:

Tuition fee	$50.00	
Laboratory or Surveying fee	5.00	
Books	5.50	
Locker fees	.50	
		$61.00

All the foregoing charges levied by the university on a student can be easily defrayed with the money earned in the shops, but students should not expect to be able to support themselves entirely on their income from the shops or by doing extra work, as the studies of the Engineering School are too exacting.

BOARD AND ROOM.

There is a dormitory in connection with the university, which will accommodate a limited number of students. The cost of room rent is from $2.00 upwards, according to the location of the room. The cost of board is $4.00 per week and upwards.

GENERAL REGULATIONS.

The enrollment card filled out at the time of enrollment must be revised when necessary. Notice of change of address, telephone number, course desired, etc., must be given at the office as soon as possible.

Unit of Credit: The unit of credit is one hour of class recitation, two hours of laboratory or three hours of drawing period per week for one semester. The credit value of each course is given under Schedule of Studies.

Tardiness or Absence from Class: Tardiness and absence from class are ruinous, not only to the individual, but to the whole class, hence they will not be tolerated. Immediately on returning after absence a written excuse must be presented at the office and a card of absence obtained. This card and excuse must be presented to the Instructor, who, if he deem the excuse valid, will arrange time and manner in which lost credits may be made up. If credits are not made up in time and manner specified, the absence shall be considered unexcused.

The final average in each subject will be lowered by the number of absences relative to the total number of periods in that subject, so that if for example, the number of absences equal one-fourth the total number of periods, one-fourth of the final average will be subtracted. Thus, a student making a final average of 80% would receive only 60% credit.

Absence from Shops: Promptness and punctuality in attendance are even more important in the shops than they are in the class-room, for on them the success of the co-operative system depends. Hence, avoidable absence from shop will be severely dealt with since it reflects on the good name of all the students in the shops. Should an unavoidable absence occur it should be reported at once by telephone to the co-ordinator, and if possible, also to the foreman of the shop. Failure to comply with this regulation often causes much avoidable annoyance to all parties concerned and will be dealt with accordingly.

DISCIPLINE IN SHOP: A student while in the shop is subject to the rules and regulations of the shop. His behavior there, not only reflects seriously upon the university, but determines his success in the course.

NOTICE OF DISCONTINUANCE OF COURSE: A student, upon enrolling in this department, does so on the condition that in case he decides to discontinue his course, he will notify the authorities of the university at least one week in advance. A week's notice is necessary so that the resultant changes in the shops can be made without disturbing the factory arrangements. Failure to serve this notice forfeits the student's right to an honorable dismissal. Withdrawal during the semester means loss of all credits for work done that semester. No fees are refunded.

STANDINGS: Records of the examinations and class-work will be kept and recorded:

Excellent	90-100
Good	80- 89
Fair	67- 79
Conditioned	55- 66
Failed	0- 54

Conditions must be removed before the beginning of the next semester. Failure means student must repeat the course before he can go to advanced work in the same department.

Courses Offered

As will be noted from the appended Schedule of Studies, three complete engineering courses are offered, Mechanical, Civil and Electrical. Each course covers a period of five years. The school year continues for eleven months.

Stress is placed on the study of principles as being the things not likely to be acquired in later life. For the first three years the studies are common to all courses, so that the student need not determine upon the particular branch until the end of his third year. The following brief synopsis of each course, coupled with the experience he will have had in the shops, will help the student to make an intelligent choice.

MECHANICAL ENGINEERING

Besides the fundamental sciences common to all branches of engineering, this course offers special opportunities in steam and gas engineering, and power plants.

The work, special to this branch, includes the designing of steam and gas engines and steam turbines, and a study of methods of power distribution and application by both mechanical and electrical means. Complete power-plant designs are made both for the generation of electrical power and for direct use in manufacturing plants, and students become familiar with all forms of steam, gas, and electrical machinery through their study and operation in the course at the university and in the shops. This course also includes the designing of shops, traveling cranes and power distribution systems. The course is intended to train production engineers and managers of manufacturing plants of all kinds.

CIVIL ENGINEERING.

The first aim is to impart as broad a scientific training as the length of the course and the essential professional studies will allow, so that as many avenues to successful service as possible may be open to the graduate. Along professional lines, emphasis is laid first, on work in surveying and field methods, as these are of special value to civil engineers; second, on mechanics and its applications to the design of roofs, bridges and other structures; third, on the theory and practice of reinforced concrete construction; fourth, on railway location and construction; fifth, on sanitary and municipal engineering, including water supply, sewerage, roads and pavements.

ELECTRICAL ENGINEERING

The course in Electrical Engineering is designed to train the student in the building of power-plants; in the electrification of shops, tunnels, railroads, cities; in the transmission and distribution of power, in telephoning, and wireless telegraphy. The co-operative plan of engineering calls for a wide and varied experience in practical electrical work. The aim of the entire course is to develop in the student those qualities which are essential to the engineer, as well as those that are essential to the electrical artisan.

Schedule of Studies

MECHANICAL ENGINEERING

FRESHMAN YEAR—FIRST SEMESTER

Subject	Course	Hours	Credits
Trigonometry	Math. 1	6	6
Chemistry	Ch. 1	4	4
Chemistry, Laboratory	Ch. 1a	6	3
Descriptive Geometry, Recitations	M. E. 1	3	3
Descriptive Geometry, Drawing	M. E. 1a	6	2
Co-ordination	C. 1	2	2
English	Eng. 1	2	2
German	Ger. 1	3	3
		32	25

FRESHMAN YEAR—SECOND SEMESTER

Subject	Course	Hours	Credits
College Algebra	Math. 2	6	6
Chemistry	Ch. 2	4	4
Chemistry, Laboratory	Ch. 2a	4	2
Descriptive Geometry, Recitations	M. E. 2	3	3
Descriptive Geometry, Drawing	M. E. 2a	9	3
Co-ordination	C. 2	2	2
English	Eng. 2	2	2
German	Ger. 2	3	3
		33	25

SOPHOMORE YEAR—FIRST SEMESTER

Subject	Course	Hours	Credits
Analytical Geometry	Math. 3	6	6
Physics (Mechanics and Sound)	Physics 1	4	4
Physics, Laboratory	Physics 1a	6	3
Co-ordination	C. 3	2	2
Qualitative Analysis	Ch. 3	1	1
Qualitative Analysis, Laboratory	Ch. 3a	6	3
English	Eng. 3	5	5
German	Ger. 3	3	3
		33	27

MECHANICAL ENGINEERING—*Continued*

SOPHOMORE YEAR—SECOND SEMESTER

Subject	Course	Hours	Credits
Differential Calculus	Math. 4	6	6
Physics (Heat and Light)	Physics 2	4	4
Physics, Laboratory	Physics 2a	6	3
Co-ordination	C. 3	2	2
Mechanisms	M. E. 3	5	5
Mechanisms (Drawing)	M. E. 3a	6	2
English	Eng. 4	3	3
German	Ger. 4	3	3
		35	28

PRE-JUNIOR YEAR—FIRST SEMESTER

Subject	Course	Hours	Credits
Integral Calculus	Math. 5	6	6
Physics (Electricity and Magnetism)	Physics 3	4	4
Physics, Laboratory	Physics 3a	6	3
Machine Drawing	M. E. 4	9	3
Mechanisms and Graphical Statics	M. E. 3b	5	5
Economics	E. 1	2	2
Co-ordination	C. 4	2	2
		34	25

PRE-JUNIOR YEAR—SECOND SEMESTER

Subject	Course	Hours	Credits
Mechanics of Engineering, Statics	C. E. 1	6	6
Surveying, Recitations	C. E. 4	3	3
Surveying Field Work	C. E. 4a	6	3
Heat Engines	M. E. 5	5	5
Metallurgy	Ch. 6	2	2
Electrical Engineering	E. E. 1	4	4
Electrical Engineering, Laboratory	E. E. 1a	6	3
Co-ordination	C. 5	2	2
		34	28

MECHANICAL ENGINEERING—*Continued*

JUNIOR YEAR—FIRST SEMESTER

Subject	Course	Hours	Credits
Mechanics of Eng. Dynamics	C. E. 2	6	6
Thermodynamics	M. E. 11	5	5
Electrical Engineering	E. E. 2	4	4
Electrical Engineering (Laboratory)	E. E. 2a	6	3
Machine Design (Drawing)	M. E. 9	9	3
Co-ordination	C. 6	2	2
Contracts	Law 1	2	2
		34	25

JUNIOR YEAR—SECOND SEMESTER

Subject	Course	Hours	Credits
Machine Design	M. E. 8	5	5
Surveying	C. E. 5	3	3
Surveying (Field Work)	C. E. 5a	6	3
Strength of Materials	C. E. 3	5	5
Machine Design	M. E. 10	8	3
Co-ordination	C. 7	2	2
Electrical Machinery	E. E. 3	4	4
Contracts	Law 2	2	2
		35	27

SENIOR YEAR—FIRST SEMESTER

Subject	Course	Hours	Credits
Steam Laboratory	M. E. 7	8	4
Steam Turbines	M. E. 18	3	3
Hoisting Machinery	M. E. 12	9	3
Gas Engines	M. E. 14	3	3
Hydraulics	C. E. 8	5	5
English (Public Speaking)	Eng. 5	2	2
Specifications	C. E. 21	3	3
Economics	E. 2	3	3
		36	26

SENIOR YEAR—SECOND SEMESTER

Subject	Course	Hours	Credits
Steam Laboratory	M. E. 13	8	4
Marine Engineering	M. E. 19	3	3
Power Plants	M. E. 15	3	3
Gas Engine Design	M. E. 16		
or			
Automobile Design	M. E. 17	8	4
Electives	..	6	6
Heating and Ventilation	M. E. 20	3	3
		31	23

CIVIL ENGINEERING

(Freshman, Sophomore and Pre-Junior Years same as Mechanical Engineering).

JUNIOR YEAR—FIRST SEMESTER

Subject	Course	Hours	Credits
Mechanics of Engineering, Dynamics	C. E. 2	6	6
Electrical Engineering	E. E. 2	4	4
Electrical Engineering, Laboratory	E. E. 2a	6	3
Topographical Drawing	C. E. 7	9	3
Co-ordination	C. 6	2	2
Thermodynamics	M. E. 11	5	5
Contracts	Law 1	2	2
Astronomy	C. E. 9	3	3
		37	28

JUNIOR YEAR—SECOND SEMESTER

Subject	Course	Hours	Credits
Surveying	C. E. 5	3	3
Surveying, Field Work	C. E. 5a	6	3
Strength of Materials	C. E. 3	5	5
Electrical Machinery	E. E. 3	4	4
Civil Laboratory	C. E. 22	4	2
Co-ordination	C. 8	2	2
Roof Trusses	C. E. 10	7	3
Roads and Pavements	C. E. 20	3	3
Contracts	Law 2	2	2
		36	27

SENIOR YEAR—FIRST SEMESTER

Subject	Course	Hours	Credits
Framed Structures	C. E. 11	5	5
Hydraulics	C. E. 8	5	5
English, Public Speaking	Eng. 5	2	2
Economics	E. 2	3	3
Masonry	C. E. 15	9	5
Civil Engineering, Laboratory	C. E. 22a	6	3
Plate Girder Design	C. E. 13	6	2
Specifications	C. E. 21	3	3
		39	28

SENIOR YEAR—SECOND SEMESTER

Subject	Course	Hours	Credits
Higher Structures	C. E. 12	4	4
Water Supply	C. E. 18	3	3
Sewerage	C. E. 19	2	2
Bridge Design	C. E. 14	7	3
Arch Design	C. E. 17	8	4
Reinforced Concrete	C. E. 16	3	3
Railroad Surveying	C. E. 6	3	3
Railroad Surveying, Field Work	C. E. 6a	6	3
		36	25

ELECTRICAL ENGINEERING

(Freshman, Sophomore and Pre-Junior Years same as Mechanical Engineering).

JUNIOR YEAR—FIRST SEMESTER

Subject	Course	Hours	Credits
Mechanics of Eng. Dynamics	C. E. 2	6	6
Electrical Engineering	E. E. 2	4	4
Electrical Engineering, Laboratory	E. E. 2a	6	3
Electrical Design	E. E. 4	9	3
Thermodynamics	M. E. 11	5	5
Co-ordination	C. 6	2	2
Contracts	Law 1	2	2
		34	25

JUNIOR YEAR—SECOND SEMESTER

Subject	Course	Hours	Credits
Electrical Machinery	E. E. 3	4	4
Electrical Power Transmission	E. E. 5	3	3
Machine Design	M. E. 8	5	5
Strength of Materials	C. E. 3	5	5
Surveying	C. E. 5	3	3
Surveying Field Work	C. E. 5a	6	3
Co-ordination	C. 9	2	2
Contracts	Law 2	2	2
		30	27

SENIOR YEAR—FIRST SEMESTER

Subject	Course	Hours	Credits
Steam Turbines	M. E. 18	3	3
Economics		3	3
English (Public Speaking)	Eng. 6	2	2
Steam Laboratory	M. E. 7	8	4
Electrical Design	E. E. 6	9	3
Electives		3	3
Specifications	C. E. 21	3	3
Hydraulics	C. E. 8	5	5
		36	26

SENIOR YEAR—SECOND SEMESTER

Subject	Course	Hours	Credits
Power Plants	M. E. 15	3	3
Electrical, Laboratory	E. E. 11	8	4
Electrical Railroads	E. E. 7	4	4
Electives		6	6
Thesis		6	6
Illumination	E. E. 10	3	3
		30	26

Description of Studies

MECHANICAL ENGINEERING

M. E. 1. DESCRIPTIVE GEOMETRY:—The first half of this course consists of practice in lettering, use of instruments, construction of geometrical figures and practice in drawing irregular curves. It is designed to give the student the necessary experience in drawing, to enable him to execute neat and accurate descriptive geometry plates. The last half covers that part of Descriptive Geometry which deals with the representation and solution of problems regarding right lines and planes. Lectures, recitations and drawing periods.

M. E. 2. DESCRIPTIVE GEOMETRY (Continuation of M. E. 1):—This course takes up plane and space curves; surfaces, such as single curved, double curved and warped; planes tangent to surfaces; lines of intersection and developments. Lectures, recitations and drawing periods.

M. E. 3. MECHANISMS:—Investigation of the laws of kinematics with a study of practical machines which illustrate them. Practical problems in differential screws, worms and wheels, pulleys, belts, cams, link work, wheels in trains, and curves for gear teeth are solved both analytically and graphically. Lectures, recitations and drawing periods.

M. E. 4. MACHINE DRAWING:—Drafting room standards, including dimensioning, cross sectioning and representing screw threads, bolts, nuts, etc., are first taken up. Complete mechanical drawings are then made from sketches, and finally, drawings of machine parts from models. The method employed is that of making free-hand sketches from which the detail drawing is made. From the detail drawings, assembly drawings are made, thus checking their completeness. Some time is spent in tracing and blue printing. Great care is exercised in this course to give the student a knowledge of the best practice used in the most modern drafting rooms.

M. E. 5. HEAT ENGINES:—The principal power-producing machines are here studied, but principally the steam boiler and engine, and the gas producer and gas engine. Considerable time is given to the steam turbine.

M. E. 6. VALVE GEARS:—A study of the various kinds of valves used on steam and gas engines is taken up. A study is made of the Zeuner and Bilgrim diagrams with problems applied to steam valves. Considerable time is given to the study of the Stephenson, the Walschaert and the Joy Valve Gears. Governors are also considered.

M. E. 7. MECHANICAL LABORATORY:—The aim in this course is to give the students actual practice in the use of steam engine testing apparatus. With this in view they are taught to calibrate steam engine indicators, thermometers, gauges, etc. The determination of the calorific value of coal, gas and oil is also taken up. The students' services as helpers will be offered to engineers in the city who are making tests on plants of all descriptions.

M. E. 8. MACHINE DESIGN, THEORETIC:—This is a course in which the theory taken up in C. E. 1 and 2 is used in designing machine parts. These parts include bolts, journals, shafts, pulleys, gears, connecting and piston rods, and frame works of machines. Recitations and lectures only.

M. E. 9. MACHINE DESIGN, DRAWING:—The design of boiler and steam engine parts is worked out carefully in the drawing room. This course gives the student ample opportunity to apply the principles learned in M. E. 8. As in all other drawing courses, reliable and practical working drawings are insisted upon.

M. E. 10. MACHINE DESIGN, TOOLS:—Design of jigs, fixtures, and other machine tools.

M. E. 11. THERMODYNAMICS:—In this course a study is made of the properties of gases and vapors under different conditions, as applied to the steam and gas engine, air compressor and refrigerating machine.

M. E. 12. HOISTING MACHINERY:—The object of this course is to give the student an opportunity to apply the theory of M. E. 8 to a structural machine,—the design of columns, girders, ropes and sheaves is included.

M. E. 13. STEAM LABORATORY:—Some of the time allotted to this course will be spent in the university laboratory, but the course consists principally in testing engines, turbines, boilers, etc., in plants about the city.

M. E. 14. GAS ENGINES:—This is a course of lectures and recitations covering the various types of gas engines. It includes a study of gas engine operation, testing and installation.

M. E. 15. POWER PLANTS:—The arrangements, size and cost of the various units that are necessary in laying out a power house are here studied. Specifications for steam plants are also taken up.

M. E. 16. GAS ENGINE DESIGN:—The design of a stationary gas engine is worked out.

M. E. 17. AUTOMOBILE DESIGN:—The principal parts that go into the automobile are carefully laid out, and working drawings made.

M. E. 18. STEAM TURBINES:—This course consists of lectures, recitations and problems covering the theory and construction of steam turbines. It includes a study of the principal points of both impulse and reaction turbines, such as nozzles, blades, etc., along with the commercial types. Efficiency and adaptability of turbines, as compared with other power producers, is an important feature.

M. E. 19. MARINE ENGINEERING:—A brief study is made of the engineering equipment of ships, such as types of engines, boilers, condensers, screws, paddle wheels, etc. The lake steamers will be considered principally.

M. E. 20. HEATING AND VENTILATING:—In this course a study is made of the methods employed in heating and ventilating residences, shops and offices. The various kinds of heating systems, as hot water, direct and indirect steam, and hot air, are studied. Typical plants in the city are inspected and discussed. Lectures will be given by prominent engineers.

CIVIL ENGINEERING

C. E. 1. MECHANICS OF ENGINEERING. STATICS:—This course includes that part of mechanics dealing with bodies in equilibrium. It includes the study of forces and their composition and resolution by analytic and graphical methods; moments and the funicular polygon; the analysis of stresses in the simpler perfect frames. Friction and its laws, centers of gravity, the mathematical treatment of moment of inertia and radius of gyration and products of inertia. Suspended cables are also considered at length. *Six hours recitation per week.*

C. E. 2. MECHANICS OF ENGINEERING. DYNAMICS:—This part of mechanics considers the subjects of velocity and acceleration in both rectilinear and curvilinear motion, simple harmonic motion; motion and force; translation and rotation; work, energy and power and their measurements. Dynamometers, kinetic friction, rolling friction, momentum and impulse. *Six hours recitation per week.*

C. E. 3. STRENGTH OF MATERIALS:—The resistance of engineering materials to their loads by means of internal stress is studied in this course. The simple stresses and strains, tension members and short columns, torsion and shafts and springs, and the design of riveted joints are studied. In flexure the shears and moments are studied analytically, and by their diagrams, the strength and stiffness of beams are considered. Continuous beams and elastic deflection are studied by the geometrical treatment. Bending by oblique forces, combined torsion and bending, and other combined stresses. Long columns, their theory and the various empirical formulae used in design. Working stresses. *Five hours recitation per week.*

C. E. 4. LAND SURVEYING:—The methods of land surveying as applied to ordinary surveys for boundaries and area and to differential and profile levelling are studied, special attention being paid to the geometrical basis of the various methods. The United States Public Land Survey system is studied in detail. The adjustments of the transit and level receive particular attention, stress being laid upon them as applications of Descriptive Geometry. The computations of traverses and area. and the making of profiles and plotting are discussed in class and then performed by the student. *Three hours per week.*

C. E. 4a. SURVEYING FIELD WORK:—The methods explained in C. E. 4 are applied in this course to actual surveys for area, traverses and simple levelling. Work within satisfactory limits of accuracy is required and neat field notes are insisted upon. *Six hours field work per week.*

C. E. 5. ADVANCED SURVEYING:—This course includes the theory of refined surveying methods as applied to city, topographical, bridge and marine surveying. Field astronomy and those methods of geodetic surveying applicable to plane surveying of high accuracy are also studied. *Three hours recitation per week.*

C. E. 5a. SURVEYING FIELD WORK:—This course includes the field work illustrating the theory of C. E. 5. Part of the work is the complete topographic survey of a portion of the city and the mapping of it, showing all topographic and cultural detail. *Six hours field work per week.*

C. E. 6. RAILROAD SURVEYING:—The theory of reconnaissance preliminary and location survey is discussed with special reference to economic location. Simple, compound and reversed circular curves are studied and then the same curves are modified by easement curves of the common types. Switches, turnouts and yard layouts are designed in conformity with modern practice. Excavation and embankment are studied and calculated. Culvert and bridge foundations are staked out and waterway computed. The mass diagram for earthwork is also studied. *Three hours class work.*

C. E. 6a. RAILROAD SURVEYING FIELD WORK:—The preliminary survey for a railroad about three miles long is made and mapped, a location and grade decided upon and the final location and earthwork staked out and computed. A final estimate of cost and accurate maps are required. Some time may be spent with the surveying parties of the railroads in the city. *Six hours field work.*

C. E. 7. TOPOGRAPHICAL DRAWING:—A study is made of the various methods used in representing hydrography, surface relief and culture on maps, both in water color and by the pen. Formal lettering and neat title work are considered, and the best practice as shown in the maps of the various Federal surveys is followed as a guide. *Two hours class and seven hours drawing per week.*

C. E. 8. HYDRAULICS:—This is a study of the statics and dynamics of water. The flow of water through pipes, tubes and orifices, over weirs, and in conduits, channels and rivers is considered,—friction being given strict attention. The methods and instruments used in hydraulic surveys are studied, and practical surveys are made in the Detroit River. *Five hours recitation per week.*

C. E. 9. ASTRONOMY:—This is a short course in the applications of astronomy to the needs of the civil engineer. The fundamental ideas of latitude, longitude, time and azimuth are studied, their relations in the astronomical triangle are considered, and problems requiring familiarity with the Nautical Almanac are solved. In the field work, observations for latitude, longitude, time and azimuth are made and reduced. *One hour class and two hours field work per term.*

C. E. 10. ROOF TRUSSES:—The analysis of stresses in roof trusses is continued from C. E. 1 and is supplemented by the graphical determination of stresses in the common types of roof trusses under both inclined and vertical loads. The drafting room work includes the complete design of a knee braced truss and of another simple frame. *One hour recitation and six hours drafting work per week.*

C. E. 11. FRAMED STRUCTURES:—The analytical and graphical methods used in determining the stresses in tension members, columns and beams of railroad bridges under the various distributed and concentrated loadings are thoroughly studied. *Five hours recitation per week.*

C. E. 12. HIGHER STRUCTURES:—This is a continuation of C. E. 11, with special reference to arches, draw spans, and special types of trusses. Camber and deflection are considered briefly. Steel framed buildings are analyzed and their stresses determined. *Four hours class per week.*

C. E. 13. PLATE GIRDER DESIGN:—This course calls for the complete design of a plate girder railroad bridge. *Six hours per week.*

C. E. 14. BRIDGE DESIGN:—In this course a pin connected railroad bridge of about 150 feet span is completely designed. *One hour recitation and six hours drafting work per week.*

C. E. 15. MASONRY AND CEMENT THEORY:—The structural mechanics of the various kinds of masonry, the applications of masonry to foundations, voussoir arches, dams and retaining walls and the proper proportioning of concrete are considered in the class. In the drafting room a voussoir arch and a gravity retaining wall are designed and abutments for the bridges studied in C. E. 13 and C. E. 14 are designed. *Three hours class and six hours drafting work per week.*

C. E. 16. REINFORCED CONCRETE:—The theory of reinforced concrete in general and the various commercial reinforcements in particular are studied, as well as their application to retaining walls, dams and the different types of beams, columns and flat slabs. *Three hours class per week.*

C. E. 17. ARCH DESIGN:—The special applications of reinforced concrete to the arch are considered in the class room and applied in the drafting room to the design of a practical arch. Designs are also made for a reinforced concrete retaining wall and a small reinforced concrete building. *Two hours class and six hours drafting work per week.*

C. E. 18. WATER SUPPLY:—The engineering features of a municipal water supply are studied and the student designs a supply system for a medium sized city. *Three hours class per week.*

C. E. 19. SEWERAGE:—The collection and removal of storm water and household wastes and the design of a practical system is studied in this course. *Two hours class per week.*

C. E. 20. ROADS AND PAVEMENTS:—The engineering and economic features of country and city road improvements are studied. *Three hours class per week.*

C. E. 21. SPECIFICATIONS:—A study is made of the various requirements of good typical specifications and the reasons for their inclusion. The student then writes specifications for structures or material that differs in detail from that studied in the class work. *Three hours class per week.*

C. E. 22. CIVIL ENGINEERING LABORATORY:—Tension, compression, torsion and bending tests of the various materials used in construction are made and the results checked against the theoretical values. Some time is spent on hydraulic testing and considerable time in the cement laboratory. *Six hours per week.*

C. E. 23. GEODETIC SURVEYING:—This course is given if sufficient students elect to take it. It will deal principally with the methods of geodetic surveying and the application of the Method of Least Squares to the adjustment of observations. *Two hours class per week.*

ELECTRICAL ENGINEERING.

E. E. 1. DIRECT CURRENT MACHINERY:—In this course a partial review of that part of physics which deals with electricity is first taken up. This is followed by a careful study of the direct current motor, generator, the storage battery, etc. On account of the important part that electricity now plays in nearly every engineering project, this course is required of all students, and is made very thorough. The course consists of lectures, problems and recitations.

E. E. 1a. DIRECT CURRENT, LABORATORY:—Actual tests are made to determine the efficiency, performance, etc., of various types of direct current machines.

E. E. 2. ALTERNATING CURRENT MACHINERY:—The object of this course is to give the student a fair understanding of the alternating current and its many important applications. The motor, generator, converter, mercury arc rectifier and transformer are studied in detail.

E. E. 2a. ALTERNATING CURRENT MACHINERY, LABORATORY:—Tests are made upon the various machines, both in the university laboratory, and in the power plants of the city.

E. E. 3. ELECTRICAL MACHINERY:—This course reviews courses E. E. 1 and 2, and takes up in greater detail the machines studied therein. Special study is made of the theory of the alternating current and its application. Operation of electrical machinery is an important item.

E. E. 4. DIRECT CURRENT ELECTRICAL DESIGN:—In this course the complete design is made of a direct current motor and an electromagnet. Practical working drawings are insisted upon.

E. E. 5. ELECTRIC POWER TRANSMISSION:—The central electrical station, and long distance transmission lines are studied.

E. E. 6. ALTERNATING CURRENT ELECTRICAL DESIGN:—This course is similar to E. E. 4, but considers only alternating machines, such as transformers, converters, etc.

E. E. 7. ELECTRICAL RAILROADS:—The aim here is to give the student a fair idea of the solution of the principal problems met in electrical railroads. These include the determination of power required by trains, methods of electrical transmission, arrangement of schedules, etc.

E. E. 8. ELECTRICAL DESIGN:—The electrical part of the installation of a modern power house is designed. Details of the switchboards, conduits, generators and motor settings are made.

E. E. 9. TELEPHONES:—A study is made of the theory of the electrical transmission of speech. Long distance and local systems are investigated. Time is given to the inspection of central stations, and wherever possible, lectures by telephone experts are given.

E. E. 10. ILLUMINATION:—A study is made of the theory of illumination, and the practical methods employed in furnishing light for streets and buildings.

E. E. 11. ELECTRICAL LABORATORY:—Advanced experiments with electrical machinery, and the testing of machines. As far as possible these tests will be made in the electrical plants of the city.

MATHEMATICS.

1. TRIGONOMETRY:—Definitions and relations of trigonometric functions; logarithms; solutions of trigonometric equations. Determination of sides, angles and areas of right and oblique triangles in both plane and spherical trigonometry. Practice in the use of logarithmic and trigonometric tables, and solution of original problems.

2. ADVANCED ALGEBRA:—Review of surds, imaginaries and quadratic equations and their geometrical representation. Special study is made of binomial theorem, permutations and combinations, convergence and divergence, theory of equations, partial fractions.

3. ANALYTICAL GEOMETRY:—The object of this course is to familiarize the student with analytical methods of investigation; representation of the straight line, circle, parabola, ellipse and hyperbola by means of equations. A short time is devoted to solid analytic geometry.

4. DIFFERENTIAL CALCULUS:—A very thorough course in differential calculus is given, including variables, functions and limits, differentiations, maxima and minima, radii and centers of curvature and tracing of curves.

5. INTEGRAL CALCULUS:—Methods of integration as applied to finding of areas, volumes, length of curves, and moments of inertia.

CHEMISTRY

1. INORGANIC CHEMISTRY:—A study of the occurrence, preparation, physical and chemical properties of non-metals. Their use and application in the arts. Symbols and equations. Laws of definite and multiple proportion. Equivalent, molecular and atomic weights. Oxidation, reduction, decomposition, dissociation, ionization and hydrolysis.

2. INORGANIC CHEMISTRY:—A thorough study of metals, their classification, their use in engineering problems. Kinetic molecular hypothesis. Theory of solution and dissociation. Colloids, hydrosols and hydrogels. Chemical equilibrium, ionization and the interaction of ionic substances. Ionic theory of precipitation and solution, complex ions.

1a and 2a. CHEMICAL LABORATORY:—A selection of experiments will enable the student to familiarize himself with the elements and compounds, but especially fit him to attack the problems that may present themselves to the practical engineer.

3. QUALITATIVE ANALYSIS:—Analytical actions, separations and identifications in the light of modern theories of ionic solution and equilibrium.

3a. QUALITATIVE LABORATORY:—In the laboratory, selected reactions and separations which exercise the observational and reflective powers of the student, whilst giving the technical knowledge necessary to discover the constituents of simple alloys, ores and minerals.

4. QUANTITATIVE ANALYSIS:—Determination of exact amount of each of the different constituents in any compound. Gravimetric and volumetric. Elective.

5. ORGANIC CHEMISTRY:—Introduction to the carbon compounds and their principal derivatives. Elective.

6. METALLURGY:—Fuels and other means of obtaining high temperatures: Furnaces and their accessories. Treatment of the principal iron ores. Metallography.

GENERAL PHYSICS

Instruction in Physics is given by lectures illustrated by numerous demonstrations and by recitations from lessons assigned in a text-book. The object of the course is to acquaint the student with experimental facts, as well as with the quantities used in Physics and the theory and method of calculation. Particular attention is given to the fundamental principles and the solution of problems of a practical nature. A special effort is made to adapt the course to the needs of technical students. For this reason most of the time will be given to such subjects as are correlated to later technical work.

The course includes the treatment of the mechanics of solids, liquids and gases; heat, sound, light, magnetism and electricity.

LABORATORY PHYSICS:—The laboratory experiments are intended to give the students,—not only a practical knowledge in the use of standard apparatus, and training in the methods of making and recording physical measurements,—but also a firmer grasp and clearer insight into the physical laws and phenomena. More stress is laid on the grasp of principles and personal resourcefulness on the part of the student than on mere skill in following a set of directions. The student is required to keep an accurate and detailed record of every experiment performed. The work required is not only accurate, but as far as possible, individual,—and great importance is laid on the discussion of the sources of error.

Accurate measurements of length, mass and density, by means of comparator, cathetometer and balance; the determination of the constants of gravity, inertia and elasticity; calorimetric measurements; the use of the spectroscope, spectrometer, polariscope, and grating; determination of the velocity and pitch of sound; magnetic and electrical measurements are among the more important exercises.

ECONOMICS

Introductory: Definitions.—Political Economy, Economic Laws. Economic goods, positive and negative. Personal goods. Wealth. Consumable and productive goods. Value, individual and social. Exchange. Price, cost, labor. Income. Capital. Expenditure.

Production. Productive capacities of the Earth. Two factors of Production. Points of Physical Geography. Important conclusions. Limitations of Earth's Resources. Intensity of Production. Law of Diminishing Returns. Suitable Degree of Intensity.

Productive powers of man. Variations depending on race, nationality, morality. General and technical education.

Industrial Organization. Nature, varieties, extent, advantages, drawbacks; physical, moral, economic. Misconception on division of Labor and Machinery.

Industrial Progress. Meaning and kinds. Historical Survey. The Industrial Revolution. Its effects. False explanation of unsatisfactory conditions today. The true explanations.

Industrial Locality and Dimension. Conditions and Advantages of Localization. Growth of Cities. Industry and Business. Varieties of large and small scale Industries. Advantages and Drawbacks of large and small. History of co-operation.

Consumption. Meaning of Consumption. Limits of human wants. Theory of marginal value. Absolute and conventional necessaries. Standard of Life. Superfluities and Luxuries. Food: What it embraces. Famines and their prevention. The Housing Problem in modern cities. Fuel and Light. Clothing and Adornment. Furniture. Medical Expenditure. General Education. Religious Expenditure. Cost of Justice and of Recreations.

Population and Subsistence. Malthusianism. Declining Birthrate. Increasing means of Substance. Extravagance. Unused Resources. Colonization. Malthusianism and Providence.

Exchange. Reasons for Trade. Market Prices. Monopoly Prices. Different kinds of Monopoly. Why Monopolies exist. The Proper Remedy for the Evils of Monopoly. Differential gains and the factors producing them. Their Capitalization. International Trade. Its Nature, Advantages and Drawbacks. Free Trade versus Protection.

Money: Need and Nature of Money. Kinds of money at different periods. Token Money. Credit. Different kinds and uses of banks. The Clearing System. Commercial Use of Securities. International Exchange. Use and Abuse of Commercial Credit. Uncommercial Credit and its Dangers.

Distribution. Profits:—Rate, Amount, Real, Nominal. Mobility of Labor and Capital as tending to equalize Profits. Interest, meaning and kinds. Rate and amount: Reasons for varying rate. Mobility of Labor and Capital as affecting rates of. Wages: rate and amount, real and nominal, maximum and minimum. Wages and Cost of Living. Pessimist and Optimist Wage-theories. Riches and Poverty from the economical and ethical standpoint. Wisdom and folly of the War on Riches; Communism, Anarchism, Socialism, Collectivism, Socialization of Land.

ENGLISH

FRESHMAN

The first year's English consists of a brief review of the principles of rhetoric with special attention to the theme and paragraphic unit. Theme writing is begun at once with special emphasis upon a clear and concise expression of thought. The student is soon required to write reviews of leading articles in current scientific periodicals, the aim constantly being to obtain a natural and exact expression of thought.

One hour per week is spent in text book study, which also comprises a study of English and American masterpieces, and one hour per week is given to theme work, as noted above, throughout the freshman year. (Courses Eng. I. and Eng. II.)

Unless the student already possesses a literary education, he is also required to do a certain amount of outside reading. This reading comprises works of poetry, fiction, essays, history, biography and science.

READING REQUIRED OF FRESHMAN STUDENTS

The following course of reading is required of all freshmen in this department. The object of the requirement is to supplement the regular class work by giving the student examples of well-rendered thought, as presented by the best writers in the several departments of literature.

Such literature, when earnestly read, will also necessarily broaden the student's knowledge and stimulate his powers of thought and expression.

Each student should read, during the academic year, as many books from the following lists as will give him a total credit of 75 points. Students having credit in college literary work will be credited for such work, and will not be required to do the full 75 points of reading.

I. SCIENCE

FISHER, MRS. A. B.:—A Short History of Natural Science, (25).
NEWCOMB, SIMON:—Astronomy for Everybody, (25).
CLERK, AGNES:—History and Astronomy in the 19th Century, (25).
WASMANN:—Modern Biology and Evolution, (25).
WALSH, J.:—Thirteenth Greatest of Centuries, (20).
NORTON:—Elements of Geology, (20).
CHAMBERLIN AND SALISBURY:—College Geology, (20).
FOURNIER:—Electron Theory, (20).
SNYDER, CARL:—New Conceptions in Science, (20).
FRANKLAND, P. F.:—Our Secret Friends and Foes, (20).
PROCTOR, R. A.:—Other Worlds Than Ours, (20); Light Science for Leisure Hours, (10).
BYRN, E. W.:—Progress of Inventions in the Nineteenth Century, (20).
SHALER, N. S.:—Nature and Man in America, (20); Man and the Earth, (15).
LUBBOCK, J.:—Scientific Lectures, (20).
DUNCAN, R. K.:—The New Knowledge (Radium, Etc.), (15).
THOMPSON, S. P.:—Light, Visible and Invisible, (15).
RUSSEL, I. C.:—Lakes of North America, (15).
ILES, G.:—Flame, Electricity and the Camera, (15).
MENDENHALL, T. C.:—A Century of Electricity, (15).
GERARD:—Old Riddle and Newest Answer, (15).
McCULLOUGH, E.:—Engineering as a Vocation, (10).
TALBOT, F. A.:—Railway Conquest of the World, (10); Steamship Conquest of the World, (10).

II. HISTORY AND BIOGRAPHY

FISKE, JOHN:—American Revolution, 2 vols., (40); Discovery of America, 2 vols., (40); Beginnings of New England, (25); Old Virginia and Her Neighbors, 2 vols., (40).
GRANT, U. S.:—Personal Memoirs, 2 vols., (40).
LEE, SIDNEY:—Great Englishmen of the Sixteenth Century, (25).
CREASY, E. S.:—Fifteen Decisive Battles of the World, (20).
RAWSON, E. K.:—Twenty Famous Naval Battles, (20).
MACAULAY, T. B.:—History of England, Vol. I., Chap. 3, (10).
HARCOURT, L. F.:—Vernon; Achievements in Engineering, (20).
MOFFETT, CLEVELAND:—Careers of Danger and Daring, (20).
COCHRANE, C. H.:—Wonders of Modern Mechanism, (20).
COCHRANE, ROBERT:—Romance of Industry and Invention, (20).
CHURCH, W. C.:—Life of John Ericcson, (20).
SMILES, S.:—Lives of George and Robert Stephenson, (20), and of Bolton and Watt, (20), in "Lives of the Engineers."
THOMPSON, S. P.:—Michael Faraday, His Life and Work, (20).
BRYCE, J.:—American Commonwealth, (20); Hindrances to Good Citizenship, (20).

COOLIDGE, A. C.:—The United States as a World Power, (20).
CATTELL, J. M.:—American Men of Science, (20).
GARNETT, W.:—Heroes of Science: Physicists, (20).
JORDAN, D. S.:—Leading American Men of Science, (20).
MUIR, J.:—Heroes in Science: Chemists, (20).
PARTON, J.:—Captains of Industry, (20).
JONES, F. A.:—Life of Thomas Edison, (20).
VALLERY-RADOT:—Life of L. Pasteur, (20).
MORSE, J. T., JR.:—Life of Abraham Lincoln, (20).
THORPE, T. E.:—Humphrey Davey, Poet and Philosopher, (20).
BREWSTER, SIR DAVID:—Life of Sir Isaac Newton, (20).
CLERKE, MISS A. M.:—The Herschels and Modern Astronomy, (20).
GLAZEBROOK, R. T.:—James Clerk Maxwell, (20).
FRANKLIN, BENJAMIN:—Autobiography, (10).

III. FICTION

BULWER-LYTTON, E. L.:—The Last Days of Pompeii, (25).
DICKENS, CHARLES:—A Tale of Two Cities, (20); David Copperfield, (20).
SCOTT, WALTER:—Woodstock, (20); Guy Mannering, (20); Kenilworth, (20); Quentin Durward, (20); Waverly, (20).
STEVENSON, R. L.:—Kidnapped, (20).
HAWTHORNE, NATHANIEL:—The House of Seven Gables, (20).
COOPER, J. F.:—The Pilot, (20); The Spy, (20).
ALLEN, JAMES LANE:—The Reign of Law, (20).
KIPLING, RUDYARD:—Captains Courageous, (15).

IV. ESSAYS AND POETRY

LAMB, CHARLES:—Essays of Elia, (25).
DANTE:—Inferno, Norton's Translation, (25).
HOMER:—Iliad, (25); Odyssey, (25).
TENNYSON, ALFRED:—In Memoriam, (20); Maud, (20).
BROWNING, R.:—Pippa-Passes, (10); A Soul's Tragedy, (20); Strafford, (20).
SHAKESPEARE:—Hamlet, (15); Othllo, (15); The Merchant of Venice, (15); Macbeth, (10); The Tempest, (10); King Lear, (10); Twelfth Night, (10).

V. MISCELLANEOUS

HOLAIND:—Ownership and Natural Right, (20).
RYAN:—A Living Wage, (20).
SCOTT, W. R.:—The Americans in Panama, (20).
CLARK, F. E.:—The Continent of Opportunity, (15).
ROOSEVELT, T.:—The Winning of the West, (15).
DEVAS:—Key to the World's Progress, (15).
BATES, A.:—Talks on Writing English, (15).
GREENOUGH, J. B. AND KITTREDGE, G. L.:—Words and Their Ways in English Speech, (15).
LOUNSBURY, T.:—Standard of Usage in English, (15).

CARRINGTON, T. S.:—Fresh Air and How to Use It, (10).
OLIVER, T.:—Diseases of Occupation, (10).
WILEY, H. W.:—Foods and Their Adulteration, (10).

SOPHOMORE

The second year continues the theme work, but a large share of the subject matter is furnished by the student's shop experiences and by inspections of the many engineering problems and constructions, which only a large city can furnish. The student is encouraged to observe and to express in scientific language what he has seen. Here also the study of English and American masterpieces is continued. (Courses Eng. III. and Eng. IV.)

THE JUNIOR AND SENIOR YEARS continue the study of English as shown in the course of study. Twelve hours of English are required to satisfy the requirements for graduation, but beginning with the Junior year, the course will be largely determined by the efficiency and needs of the class. The course will constantly aim at stimulating careful observation and logical thinking, which form the basis of clear expression.

MODERN LANGUAGES

This course at present offers German only. Twelve hours are required to qualify for graduation from each course offered in the Engineering Department.

The object of the German courses is to give the student a working knowledge of reading, writing and speaking,—with special emphasis upon comprehensive reading. The medium of class communication is changed from English to German as early as is practicable.

The first year is devoted to German grammar, which is taught by the direct method, and enough theme writing and classic reading to acquire a reasonable knowledge of German idioms, constructions and methods of thought. (Courses German I. and German II.)

The second year is devoted to reading and translation of German technical works on scientific and engineering subjects.

These subjects are chosen with a view to furnishing the student with a knowledge of the nomenclature of Chemistry, Physics and such mechanical sciences as lie within the general scope of the profession of engineering. (Courses German III. and German IV.)

Students offering German as one of their entrance requirements may take the second year's technical German for part of their language credits.

LAW OF CONTRACTS

CONTRACTS:—Two hours each week throughout the year. The topics of offer and acceptance, consideration, assignment of contracts, contracts for the benefit of third persons, joint obligations, contracts within the Statute of Frauds, express and implied conditions, impossibility, contracts in restraint of trade, illegal contracts, novation, release, accord and satisfaction, arbitration and award, alteration and merger. Williston's Cases on Contracts, Vols. I. and II.

CO-ORDINATION

C.1 to C.9: These courses consist of two class periods per week at the university. The students from the various shops are brought together into one class, and their difficulties and experiences are discussed. From time to time shop superintendents and foremen are invited to send in problems and questions arising in their daily work. These, as far as possible, are worked out by the faculty engineers and students, and the class-room is made a sort of clearing house for knowledge. Whenever any subject is under consideration, such as shop management, power transmission, routing of work, limits of accuracy, feeds and cuts of machine tools, overhead costs, time keeping systems, etc., the students discuss the methods followed in the different plants. In this way a very broad idea of the work carried on in the several shops is brought to each student.

Shop mathematics, methods of setting up and doing different operations on the machines and at the bench are studied. Tables for curves are worked out for simplifying such work as cutting tapers, threads, feeds and speeds, etc. The student will, from time to time, be expected to write reports on what he has observed in the shop, and read them before the class.

INSPECTION TRIPS

Detroit offers great opportunity for visiting engineering plants of all descriptions. Among the works inspected are electric lighting, shipbuilding, automobile, railroad car, stove, steam engine, blower, and bridge companies. The material for many of the themes for the English courses will be taken from these trips.

Register of Students

Ameel, A. B	Junior
Armstrong, Albert J	Freshman
Bostick, Coral A	Freshman
Brennan, Frank J	Junior
Brusstar, William D	Freshman
Busch, Clarence W	Junior
Campbell, Douglas	Freshman
Christin, R. Ernest	Freshman
Crowe, William T	Senior
David, Hugh W	Freshman
Discher, Ernest H	Sophomore
Facchinetti, J. Lawrence	Sophomore
Farrell, Thomas E	Freshman
Ferencz, Louis	Freshman
Finn, Harold R	Sophomore
Fitzgerald, Edmund M	Junior
Fremont, Justin M	Sophomore
Glaser, Clarence	Senior
Gorey, Hugh	Freshman
Haag, Carl J	Freshman
Harrigan, Millard J	Freshman
Hendry, Mark W	Freshman
Herman, Norman B	Special
Kelly, Sherman F	Freshman
Kichlu Kunj, B.	Special
Levitan, William	Freshman
Long, Carlyle R	Freshman
Long, Cornelius J	Freshman
Lorenz, Arthur	Sophomore
McNally, Howard	Sophomore

Manion, Hugh	Sophomore
Maus, Louis T	Freshman
Mendelson, Herbert	Freshman
Menkee, Ernest D	Freshman
Millard, Lester W	Freshman
Miner, Simeon J	Freshman
Nebel, Alvin J	Junior
O'Connor, F. Gerald	Freshman
O'Donnell, Wm.	Sophomore
O'Keefe, Raymond	Freshman
O'Mara, Hugh R	Sophomore
Parker, Charles	Freshman
Philipp, Lawrence A	Freshman
Peirce, Russell	Freshman
Reno, Eugene A	Senior
Richardson, Vincent Wm	Sophomore
Rouland, Harold R	Sophomore
Shea, John	Freshman
Sheldon, Elmer J	Junior
Sinclair, Hill	Junior
Streeter, William G	Senior
Tate, Lucius C	Sophomore
Van Loon, Henry M	Special
Vervake, Albert J	Junior
Wharam, John J	Sophomore
Wilkinson, James	Sophomore
Zettel, Ray	Freshman

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